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SCIENCE 9

Module 1

Biological Diversity

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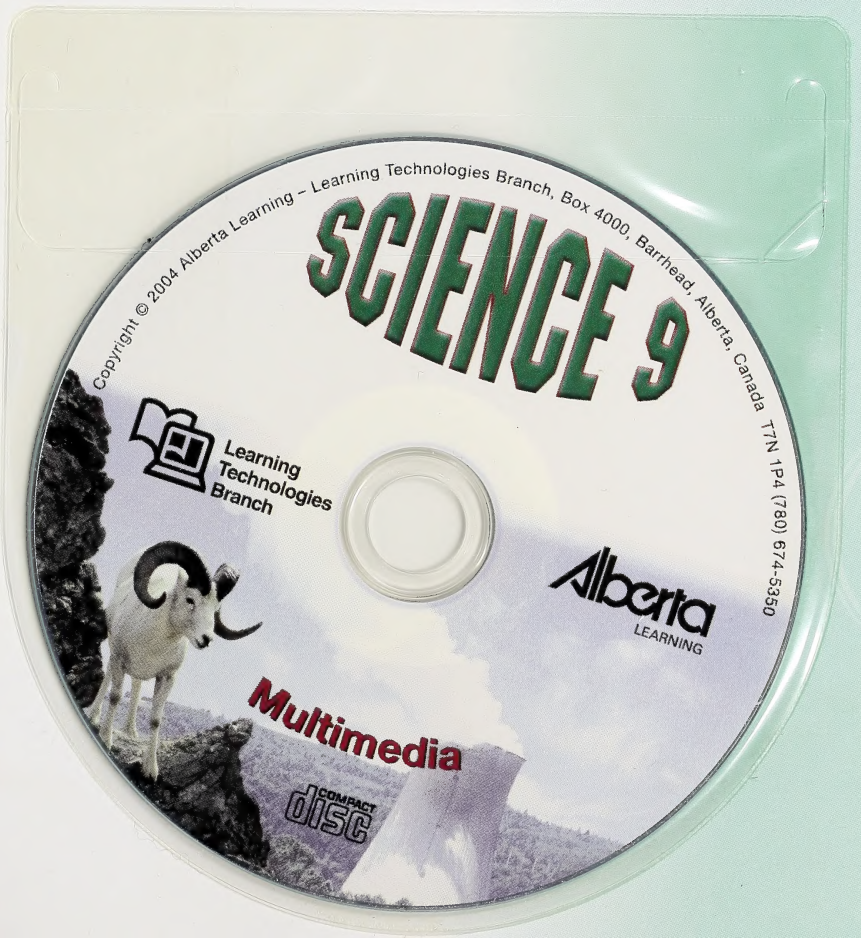
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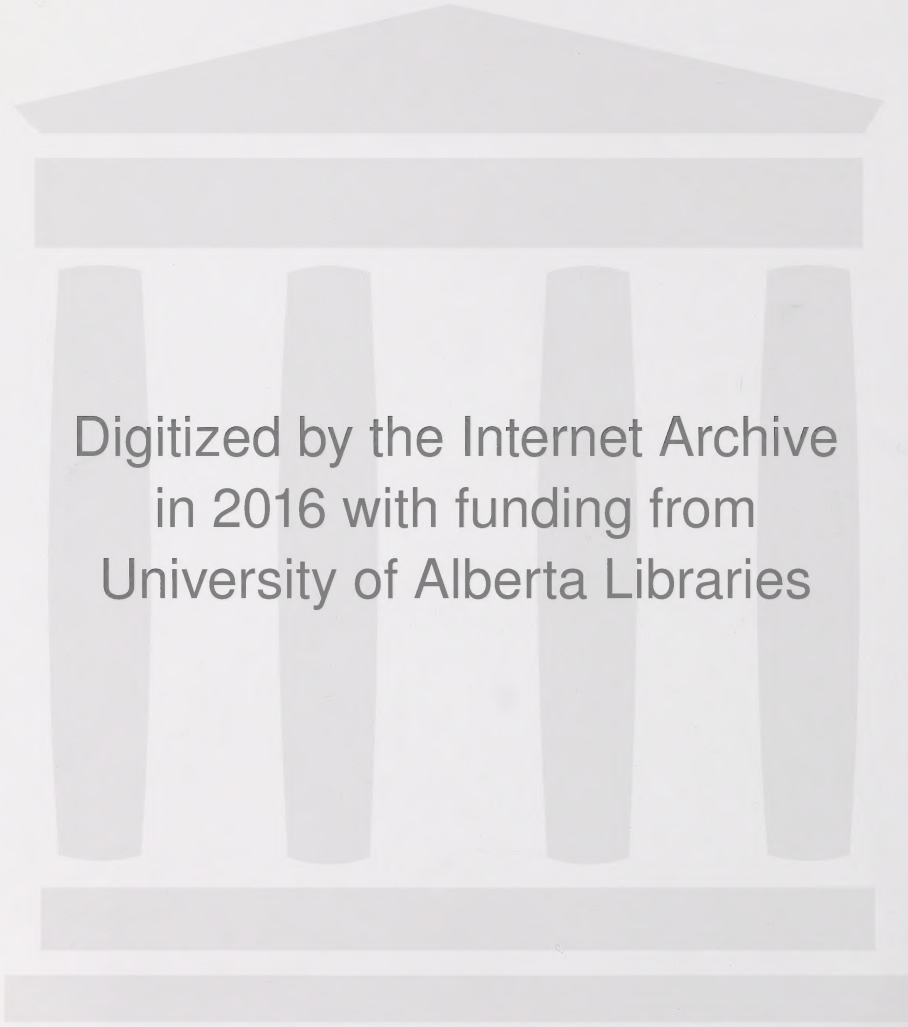
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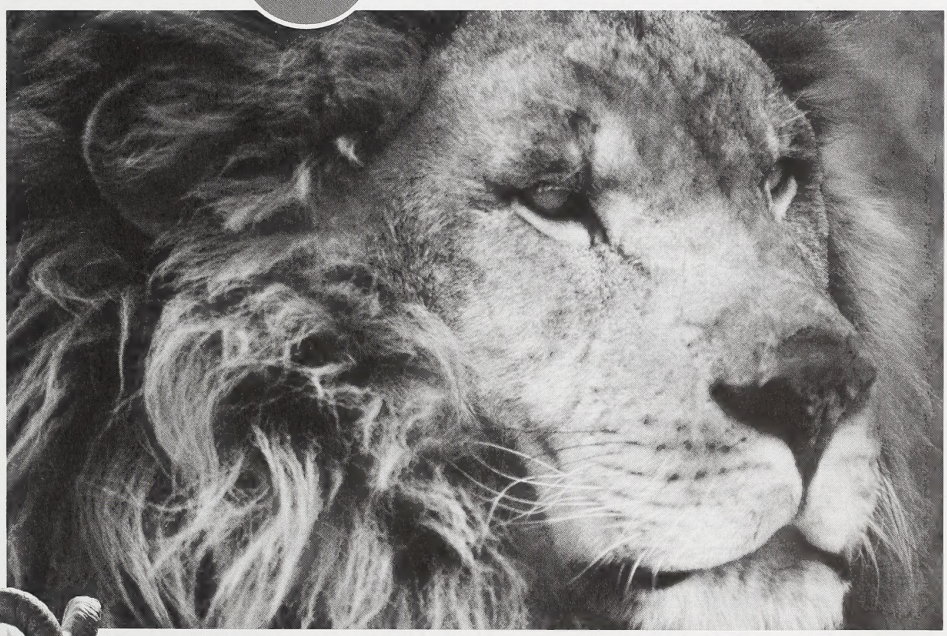
SCIENCE 9

Module 1 Biological Diversity



Science 9
Module 1: Biological Diversity
Student Module Booklet
Learning Technologies Branch
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The Learning Technologies Branch acknowledges with appreciation the Alberta Distance Learning Centre and Pembina Hills Regional Division No. 7 for their review of this Student Module Booklet.

This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	
General Public	
Other	

You may find the following Internet sites useful:

- Alberta Learning, **http://www.learning.gov.ab.ca**
- Learning Technologies Branch, **http://www.learning.gov.ab.ca/ltb**
- Learning Resources Centre, **http://www.lrc.learning.gov.ab.ca**

The use of the Internet is optional. Exploring the electronic information superhighway can be educational and entertaining. However, be aware that these computer networks are not censored. Students may unintentionally or purposely find articles on the Internet that may be offensive or inappropriate. As well, the sources of information are not always cited and the content may not be accurate. Therefore, students may wish to confirm facts with a second source.

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WELCOME to Science 9!

It is recommended that you work through the modules in order because the concepts and skills introduced in one module will be reinforced, extended, and applied in later modules.

Module 1 Biological Diversity

Module 2 Matter and Chemical Change

Module 3 Environmental Chemistry

Module 4 Electrical Principles and Technologies

Module 5 Space Exploration

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Resources

Textbook

To complete the course, you need the textbook *ScienceFocus 9*.

Multimedia

Attached to Student Module Booklets in this course are CDs titled *Science 9 Multimedia* and *Science 9 Multimedia*: *Astronomy*. These CDs contain multimedia segments designed to help you better understand particular concepts presented in this course. Ask your teacher or home instructor if you need help using these CDs.

Materials and Apparatus

A list of materials and apparatus is given on the Planning Ahead page of each Student Module Booklet. These items are needed to complete the module. Some of the materials and apparatus may be provided at your local school lab. If you don't have access to a school lab, you will need to get the loan kit. Talk to your teacher for more information.

Before You Begin

Organize your materials and work area before you begin: Student Module Booklet, textbook, notebook, pens, pencils, and so on. Make sure you have a quiet area in which to work, away from distractions.

Because response lines are not provided in the Student Module Booklet, you'll need a looseleaf binder or notebook to respond to questions and complete charts. It's important to keep your lined paper handy as you work through the material and to keep your responses together in a notebook or binder for review purposes later.

Refer to the Planning Ahead page for directions on what you need to do before you start this module.

Good luck!

Icons

This is one of five Student Module Booklets for Science 9. As you progress through this module, you will meet several icons.

Do Ahead

Some preparation must be started well ahead of the activity or investigation. E.g., start the seedlings for the investigation in Lesson 3.

Teacher or Home Instructor

The teacher or home instructor should be contacted for help, approval of some procedure, or checking answers.

Assignment Booklet

Work needs to be done in an Assignment Booklet.

Safety

You must be very careful when you see this symbol.

Textbook

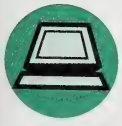
A reference is made to *ScienceFocus 9*, the student textbook for this distance learning course.

Internet

This is a reference to the Internet. **Note:** Any Internet website given is subject to change.

Multimedia

This is a reference to the *Science 9 Multimedia* CDs.



Computer

You will need to work with a computer when you see this symbol.

Module Overview

Have you ever wondered about the amazing variety of life forms? A gopher, a horsetail plant, a whale, a crab, and an elephant are very different. They represent a remarkable diversity among species of living things.

The range of species found around the world represents biological diversity. So do the small variations within individual species.

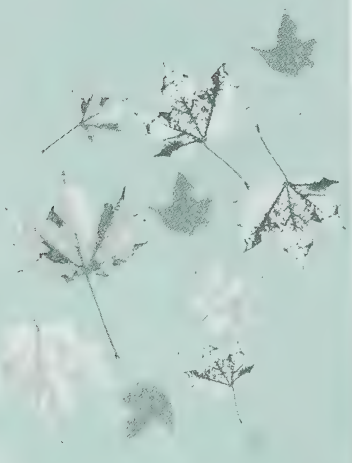
Section 1
Diversity in the Ecosystem

Section 2
Handing Down Species' Characteristics

Section 3
The Impact of Human Activities

In this module you will explore natural processes that have led to today's biological diversity. Also, you will see how human activity can lead to species dying out and to a loss of biological diversity.

Read page 2 of the textbook to find out why biological diversity is important. Then check out "Unit 1 Preview" on pages 4 and 5 of the textbook to find questions that will guide you through this module.



Assessment

The booklet you are presently reading is the Student Module Booklet. It will show you, step by step, how to advance through Module 1: Biological Diversity.

This module, Biological Diversity, has three sections. Within each section your work is grouped into lessons. Within the lessons there are readings, investigations, activities, and questions for you to do. By completing these lessons you will discover scientific concepts and skills, develop a positive attitude toward science, and practise or apply what you have learned.

Suggested answers in the Appendix of this Student Module Booklet will provide you with immediate feedback on the answers to questions in the lesson. Your teacher or home instructor will also provide you with feedback on your progress through the module.

At several points in this module you will be directed to an accompanying Assignment Booklet. Your grading in this module is based on the assignments you submit for assessment. In this module you are expected to complete three section assignments and a Final Module Assignment.

The mark distribution is as follows:

Assignment Booklet 1A	
Section 1 Assignment	18 marks
Section 2 Assignment	43 marks
Assignment Booklet 1B	
Section 3 Assignment	26 marks
Final Module Assignment	35 marks
TOTAL	122 marks

Planning Ahead

Here is a list of materials and apparatus you will need to complete this module.

Section 1	Section 2	Section 3
❑ a tape measure	❑ bread (perhaps several different types) ❑ several plastic bags—sealable or with ties ❑ a magnifying glass	❑ No extra materials are needed for this section.

If you have access to the Internet, you may want to check out some of the links for this module ahead of time. Go to the following site:

http://www.mcgrawhill.ca/school/booksites/sciencefocus+9/student+resources/toc/index.php

Section 1

Diversity in the Ecosystem

A frigate bird is a long-billed seabird. It often obtains its food by simply taking it from other birds. When you look at a male frigate bird you likely wonder why it has a large, red, throat pouch.

The pouch of the male frigate bird is used to attract a mate. This unusual adaptation adds to the diversity among birds. The diversity that exists among all living things in an area is called biological diversity.

In this section you will learn to make sense of biological diversity. Using the concept of species you will see how survival and adaptations within the ecosystem lead to biological diversity.

Lesson 1: Biological Diversity and Survival

Why do you think zebras have stripes? An adaptation involving colouring can help a zebra in several ways.

This adaptation can help zebras blend into the tall grass of their environment. This makes it hard for predators to find them. When a herd of zebras is together, all the stripes may confuse predators—the predators have trouble identifying individual zebras to attack. Zebra stripes help them survive.

In this lesson you will see how adaptations relate to the ability of organisms to survive in specific environments. You will explore **variation** both among and within species. You will come to appreciate the importance of **biological diversity** for all living things.

variation: differences in characteristics of organisms

biological diversity: the number and variety of organisms in an area

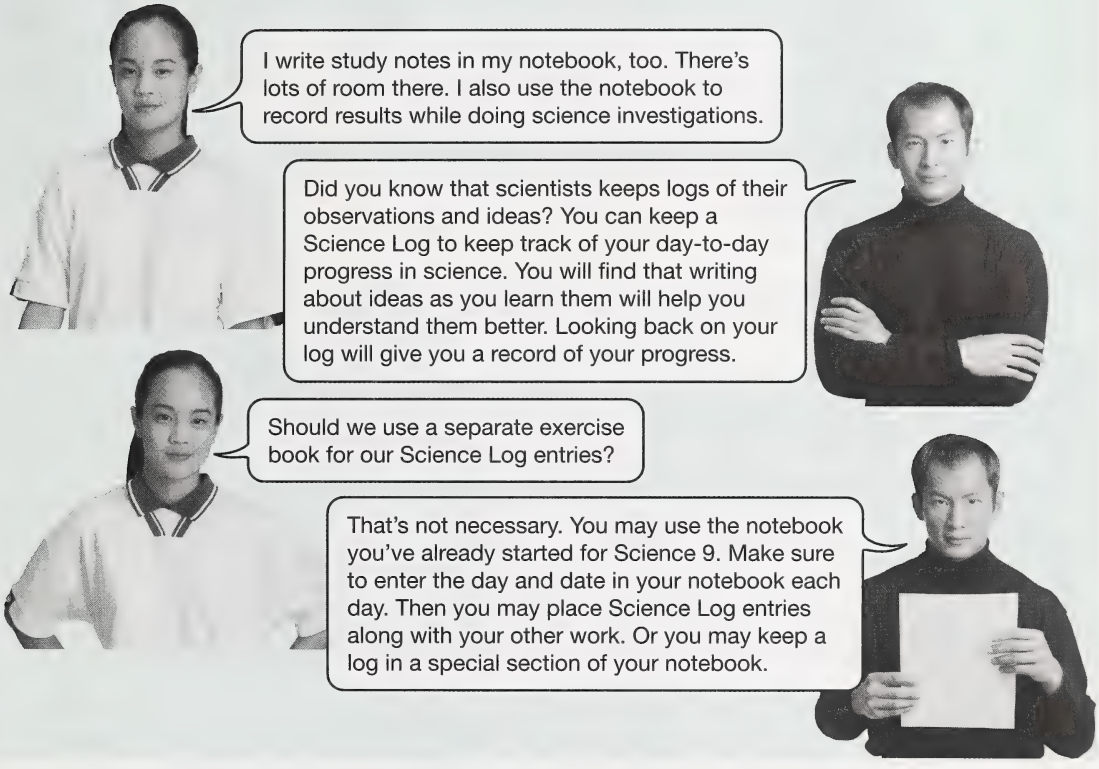
Read about variation and biological diversity on page 6 of the textbook. Then read "A Wealth of Diversity" on page 7.

1. Give two reasons why biodiversity should be preserved.

Compare your response with the one in the Appendix on page 70.

When reading pages in the textbook, remember to look at the margin items, for example, "Did You Know?" and "Word Connect." Margin items present interesting facts relating to the topic you are studying.

In this lesson, and in the rest of this course, you will be doing written work. You will sometimes be directed to an Assignment Booklet to do this written work. However, for the numbered questions in Student Module Booklets, you should answer the questions in a notebook set aside for Science 9.


I write study notes in my notebook, too. There's lots of room there. I also use the notebook to record results while doing science investigations.
Did you know that scientists keeps logs of their observations and ideas? You can keep a Science Log to keep track of your day-to-day progress in science. You will find that writing about ideas as you learn them will help you understand them better. Looking back on your log will give you a record of your progress.
Should we use a separate exercise book for our Science Log entries?
That's not necessary. You may use the notebook you've already started for Science 9. Make sure to enter the day and date in your notebook each day. Then you may place Science Log entries along with your other work. Or you may keep a log in a special section of your notebook.

For extra tips on getting the most out of a Science Log, go to the following site:

http://www.mcgrawhill.ca/school/subjects/science/_studenttips/

Variation Within Species and Among Species

Have you ever had to sort a box of nuts and bolts into individual nuts, bolts, and other types of fasteners? When you organize a collection of things you get a better sense of how they vary and how they are the same.

You can group things into nuts, bolts, washers, cotter pins, and so on. If you think of the different groups as different species, you might think of nuts as one kind of species and bolts as another. How all the nuts differ from each other and how the bolts differ from each other is variation within **species**. But how the nuts differ from bolts is variation among species.

species: a group of organisms that share similar characteristics

Generally, organisms of the same species can interbreed and produce fertile offspring.

The word *species* has a special meaning when it's used to describe groups of living things.

Turn to page 8 of the textbook. Read "Did You Know?" and "Variation Within Species."

2. Match the following items on the left with the type of variation on the right that each example represents.

___ **a.**	the differences among the cats in "Figure 1.5" on page 10 of the textbook	A. variation among species
___ **b.**	the differences among the people in "Figure 1.1" on page 6 of the textbook	B. variation within species
___ **c.**	the differences among the kittens on page 8 of the textbook	
___ **d.**	the difference between a robin and a sparrow	

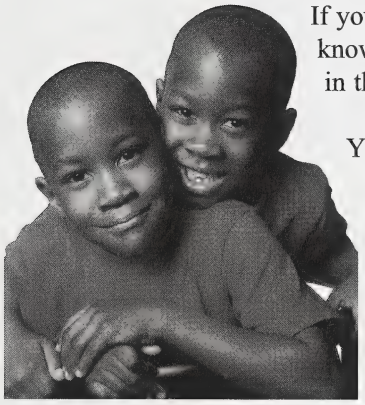
3. List two factors used to group organisms into species.

Compare your responses with those in the Appendix on page 70.

Going Further

The final "Going Further" for this module gives you an opportunity to investigate the importance of fire in natural ecosystems. You will consider its effects on human developments and activities. You will also discover its future as a conservation tool. To prepare, read "Looking Ahead" on page 5 of the textbook to get a start.

These "Going Further" sections are for those of you who want to do extra in-depth work. There are lots of interesting topics to work on.



If you have ever tried to tell identical twins apart, you know it can be very difficult. They show little variation in their physical features.

You can tell your family, friends, and community members apart because they differ from each other in many ways. They show lots of variation in their physical features.

In the next activity you will measure variation based on physical features among your classmates or another group of individuals.

Find Out Activity A Classroom of Differences

Refer to the activity on page 9 of the textbook.

Read the introductory paragraph. Instead of using students in a class, you may use family and friends as the "population" for this activity. Try to get measurements from at least 10 different people close to your own age.

Do steps 1 to 3 of "Procedure."

As you record data you may use a data table like the following to record results. Round your data to the nearest whole number of units.

Measurement of Physical Features			
Name of Person	**Height (cm)**	**Hand Width (cm)**	**Wrist Circumference (cm)**
Helen	170	16	15

Once you have the measurements recorded, make frequency tables like the following.

Frequency Table for Height		
Range (cm)	**Tally**	**Frequency**
130 to 139		0
140 to 149	||	2
150 to 159	|||	3
over 185		0

Your frequency tables will prepare you for step 5 of "Procedure."

In step 5 of "Procedure" you need to prepare histograms. Do you remember using histograms in mathematics? You may want to read the information found under "Constructing a Histogram" on page 476 of the textbook. Note that histograms are used when the x-axis represents continuous numerical data. Bar graphs are used when the x-axis does not represent continuous numerical data.

Do step 5 of "Procedure."

4. Answer questions 1 to 3 of "What Did You Find Out?" on page 9 of the textbook.

5. The histogram shows that individuals differ in terms of physical features. Infer what factors may cause variations between you and others you studied in this activity.

Compare your responses with those in the Appendix on page 70.

You have just observed and measured variation within a species. Although individuals of a species differ, individuals of different species likely differ more.

Turn to page 10 of the textbook. Read "Did You Know?" and "Variation Among Species."

6. Name the process that leads to the formation of new species from a common ancestor.

7. Why do you think the scientific classification of a species may sometimes be changed?

Compare your responses with those in the Appendix on page 70.

Members of a species can become separated into different ecosystems. Suppose the sources of food are different. Would the separated members develop differently? The Galápagos Islands, off the coast of Ecuador, are rugged, varied, and isolated. Do finches on these islands shed some light on how speciation takes place? The next investigation relates to these questions.

Refer to the "Think and Link Investigation" on page 11 of the textbook.

Read "Think About It" and then follow the steps of "What to Do."

8. Answer step 1 from "What to Do."

Compare your response to the one in the Appendix on page 71.

end of investigation

The finches are similar enough to suggest that they had a common ancestor. It seems that diversity within one common species eventually led to different species. The diversity of finches on the Galápagos Islands is now diversity among species.

Diversity and Survival

The diversity of finch beaks relates to different food sources. For example, ground finches crack and then consume seeds. The ground finch beaks are deep at the base so that the beaks are strong enough to crush seeds.

The strong beaks of ground finches are an adaptation. There are many adaptations among living things that lead to variations.

Read "Variations for Survival" and the remainder of page 12 of the textbook.

9. What structural adaptation do geckos have that lets them walk upside down?

10. Classify each of the following as a structural adaptation or a behavioural adaptation.

a. An owl can turn its head almost 180° in either direction.
b. An owl's feathers are soft and fluffy to allow for silent flight.
c. Owls are usually active at night.

Variations due to adaptations help individual organisms survive. Variations in general also help both a **population** and a **community** survive.

population: *a group of organisms of the same species found in a particular geographic area*

community: *an association of different populations of organisms in a particular environment or geographic area*

Read "The Value of Variation" and "Measuring Biological Diversity" on page 13 of the textbook. Note that an index can be a ratio that you get from a series of observations. The **diversity index** is a special type of index. The diversity index indicates biological diversity in a numerical way.

diversity index: a measure of the biological diversity in an area

11. Why is it positive if the individuals of a species vary in their characteristics?

12. Answer the questions in "Pause and Reflect" on page 15 of the textbook.

Compare your responses with those in the Appendix on page 71.

Going Further

Do you enjoy getting away from the hustle and bustle of everyday life? Then you may want the career of an interpretive naturalist.

Read "Career Connect" on page 15 of the textbook.

Use the concepts from Lesson 1 to complete the following questions.

13. Turn to page 15 of the textbook and answer questions 5 and 6 from "Topic 1 Review."

Compare your responses with those in the Appendix on page 72.

Looking Back

In this lesson you explored variation both among and within species. You made connections between adaptations and the ability to survive in specific environments. You realized the value of biological diversity.

Turn to Assignment Booklet 1A. Complete questions 1 to 3 from Section 1.

Lesson 2: Habitat and Lifestyle

Imagine going to the Antarctic or to an equatorial desert. You'd certainly have to dress differently. In the Antarctic you'd need a parka to protect you from the frigid cold. Meanwhile, in the equatorial desert you'd need a flowing garment with a head cover to protect you from the extreme heat and the sun. The place where you live—your **habitat**—would certainly affect your lifestyle.

habitat: the place where an organism lives

You can see that where you live is related to what you do to fit in. That relationship is true for all living things. Living things have structural and behavioural adaptations for both the living and non-living parts of their habitat.

niche: the role(s) of an organism or species in an ecosystem

How do habitat and biological diversity relate? Thinking about **niches** helps answer this question.

A niche has two parts: an organism's habitat and its role.

Do you notice anything strange about the roles played by the characters in the "tiger and man" graphic? It's funny to see that the roles of these characters have been reversed. They aren't occupying their usual "niche."

Things are more serious in ecosystems. Living things must fill their niche properly because their survival depends on it.

Read "The Niche: What Makes an Organism Special?" and "Variation and Competition" on pages 16 to 18 of the textbook.

competition: the struggle among individual organisms for access to a limited resource, such as food or territory

1. If two species occupy a similar niche, how can **competition** between species be reduced or avoided?

2. Explain how competition can affect the diversity of species that live in an area.

3. Refer to "Figure 1.11" on page 18 of the textbook.

   a. Answer the questions under "Figure 1.11."
   b. Do the warblers share the same niche? Explain.

Compare your responses with those in the Appendix on page 72.

You studied biomes in Science 7. You can think of a biome as a "global habitat" that is made up of a similar climate, soil, and vegetation. The living and non-living factors interact. Living things must be adapted to the general conditions within their biome. This adaptation contributes to variation between species.

Play the *Science 9 Multimedia* CD on a computer. This CD is provided to you at the front of Module 1. Once the first screen appears, select the title "Earth's Biomes" and explore. This will give you a sense of how species vary around the globe.

Broad and Narrow Niches

Imagine getting a summer job with a company that builds houses. Your role could be to bring supplies as needed to the carpenters, clean up scrap lumber around the construction site at the end of each day, cut pieces of lumber as needed, and so on.

You could say that you are a "generalist" and have a "broad" role as a worker. On the other hand, the carpenter is a "specialist" and has a "narrow" role. That is because most of the carpenter's work is focused just on putting together the wooden structure of the house.

Niches can be described as "broad" and "narrow," much like the roles of workers. Also, living things can be thought of as "generalists" and "specialists" within their environments.

Turn to pages 19 and 20 of the textbook and read "The Broad Niche" and "Diversity in the Tropics: The Dangers of a Narrow Niche." Also read the introductory paragraph of the "Find Out Activity" on page 21.

narrow niche: a highly specialized role or characteristic activity undertaken by an organism in an ecosystem

4. Explain why it is dangerous for an organism or species to have a **narrow niche**.

5. What factors contribute to the development of a **broad niche**?

broad niche: the roles or characteristic activities filled by a generalist organism

Compare your responses with those in the Appendix on page 73.

Species Living Together

Some niches involve an ongoing association between members of different species. Bees have a close relationship with flowers. The relationship between bees and flowers is a **symbiotic relation**. The blanket flower uses bees for pollination and bees use the blanket flower for food.

symbiotic relation: an ongoing interaction between organisms of different species that live in close proximity to each other

Turn to page 21 of the textbook and read "Dependencies Between Species."

6. In Science 7 you studied three types of symbiotic relationships—mutualism, commensalism, and parasitism.

   a. Try to give a brief definition for each type of relationship.

   b. What type of symbiotic relationship exists between mycorrhizae and plants that have roots? Explain your answer.

Living on the Edge

Imagine living in a cold arctic environment with snow and ice everywhere. That's what a polar bear lives with. You may be surprised to learn that niches with extreme conditions have a variety of organisms living in them.

Turn to page 23 of the textbook and read "Life in the Extreme."

7. List three specific ways in which species have adapted to extreme environments.

8. Turn to page 24 of the textbook and answer questions 1 and 2 of "Topic 2 Review."

Compare your responses with those in the Appendix on page 73.

Looking Back

In this lesson you identified niches and the role of variation in allowing closely related living things to survive in the same ecosystem. You investigated how dependencies link the survival of one species to the survival of others. You identified the role of variation in the survival of species when environmental conditions change.

Lesson 3: Wrap-up

To review the concepts of this section, turn to page 25 in the textbook and answer questions 1, 4, and 6 of "Wrap-up: Topics 1 to 2."

Check your answers with your teacher or home instructor.

Section 1 Conclusion

In this section you gained a basic understanding of biological diversity and how it helps species to survive. You described variation both among and within species. You identified niches and the role of variation in allowing closely related living things to survive in the same ecosystem. You investigated the dependencies among species. These dependencies link the survival of one species to the survival of others. You identified the role of variation in the survival of species when environmental conditions change.

You sometimes just have to wonder why an unusual organism has its own particular structure. How could it have possibly developed? Now you know from your understanding of biological diversity that there is probably an explanation for the structure.

The pitcher plant has an unusual structure. This structure may appear to be a bit wacky. But did you know that the pitcher plant is carnivorous? The pitcher–shaped structure is used as an insect trap. That special adaptation helps the pitcher plant survive in its niche. With this explanation, the structure now seems sensible.

Turn to Assignment Booklet 1A. Complete questions 4 to 7 from Section 1.

Section 2

Handing Down Species' Characteristics

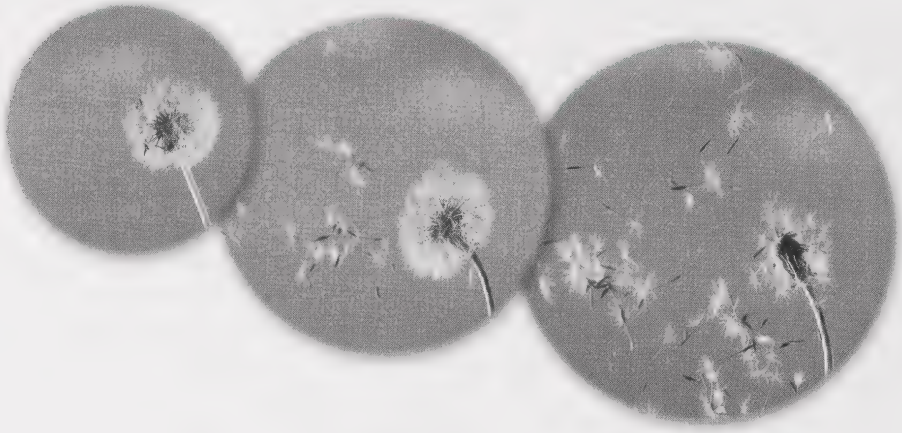
Maybe you have heard family friends say that you or one of your siblings has your mom's hair or your dad's eyes. Being able to identify characteristics that are handed down from your parents is not surprising. Other living things are also given characteristics by their parents.

These grizzly cubs certainly resemble their mother. They are clearly bears. Yet, they have differences. Scientists who study bears can learn to tell the cubs apart based on small differences in colour, size, behaviour, and so on.

During reproduction, the characteristics of species are preserved. On the other hand, offspring often display individual characteristics. How are characteristics handed down so that some stay the same and others vary?

In this section you will focus on the way characteristics are handed down during sexual and asexual reproduction. You will see how these modes of reproduction contribute to biological diversity. You will observe and identify characteristics that are inherited. You will be introduced to the role of DNA, genes, and chromosomes in carrying characteristics from parents to offspring.

Lesson 1: Reproduction and Inheritance



Dandelions produce dandelion seeds during reproduction. Can you imagine the seeds becoming spruce trees, poplars, or mushrooms? That's hard to imagine. You probably take for granted that dandelion seeds produce dandelion plants. In fact, those little seeds contain all the directions for the growth of new plants like the parent plants.

Turn to page 26 of the textbook and read the two introductory paragraphs at the top of the page.

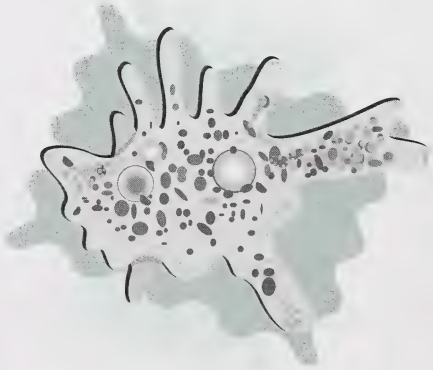
Living things show various **reproductive strategies** for passing on **heritable traits** to their offspring. You will be amazed by some of the reproduction methods.

reproductive strategies: methods used by an organism to reproduce

heritable trait: a trait that can be passed on genetically from parent to offspring

Asexual Reproduction

An amoeba is a unicellular and microscopic organism that can be found on the decaying bottom vegetation of freshwater streams and ponds. When an amoeba reproduces it just splits in two—each half becomes a new organism. That's pretty simple.



The amoeba reproduces through **binary fission**, which is a type of **asexual reproduction**.

binary fission: the splitting of a single-celled organism into two new organisms which are approximately equal in size

asexual reproduction: the formation of a new organism from a single organism

Turn to the textbook and read "Asexual Reproduction" on pages 26 to 28, and on the top of page 30.

1. The *a* in the word *asexual* means *not*. List and briefly describe four ways in which an individual organism can produce young by itself, or "not sexually."

2. How do offspring produced asexually compare with their parents?

3. List one advantage and one disadvantage of asexual reproduction.

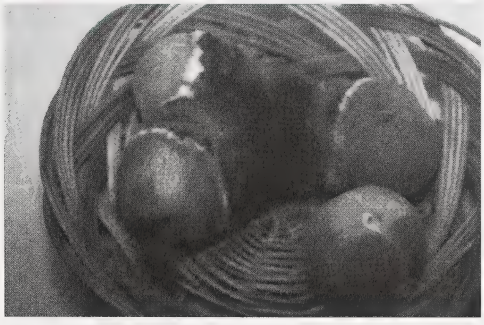
4. How is a zoospore different from a spore?

5. List two meristem functions.

6. Asexual reproduction is unusual in animals. Name an animal that is capable of asexual reproduction.

7. Answer the question under "Figure 1.25" on page 30.

Compare your responses with those in the Appendix on page 74.



When you think of mould, you may think of disgusting things like old, rotting fruit or a loaf of bread left out too long. Mouldy food is inedible. An experience with spoiled fruit or stale bread may leave you thinking of mould as a villain.

But moulds perform the valuable service of breaking down organic material into plant nutrients. In other words, moulds are decomposers. You will soon do an investigation to find out how these important organisms grow and reproduce. But first you'll need to brush up on some science inquiry skills.

Science Inquiry Skills

hypothesis: a prediction of what is expected to happen in an investigation, along with an explanation for the prediction

In the investigation of moulds you are to make a **hypothesis** and design your own procedure.

Before investigating moulds, review the processes of scientific inquiry. Study "Skill Focus 6: Scientific Inquiry" on pages 460 to 463 of the textbook. Pay special attention to these words: **manipulated variable**, **responding variable**, and **controlled variable**.

The Hypothesis

manipulated variable: the variable that is changed on purpose to see what effect the change will have on the responding variable

responding variable: the variable that changes in response to a change in the manipulated variable

controlled variable: a variable that is not allowed to change during an investigation

You make a prediction when you design a scientific investigation. Based on what you already know, what do you think will happen? A prediction backed up by an explanation is known as a hypothesis. A complete format for a hypothesis is as follows:

If you (increase, decrease, or change) the (manipulated variable), then the (responding variable) will (increase, decrease, remain the same, change, or any combination of these) because (you explain your prediction here).

This may look quite complicated, and in some ways it is. But if you look at it closely, you will see five parts. Here is a hypothesis written out with one part per line.

If you _____
(increase, decrease, or change)

the _____,
(manipulated variable)

then the _____
(responding variable)

will _____
(increase, decrease, remain the same, change, or any combination of these)

because _____.
(you explain your prediction here)

When you write a hypothesis, think of the five parts. You just plug them into the formula and you have a hypothesis.

Control | **Plant Fertilizer Type A** | **Plant Fertilizer Type B**

Here is a sample hypothesis related to an investigation represented by the illustration. It's about plant growth and plant food.

If you *change*
the *type of fertilizer a plant receives*,
then the *height of the plant*
will *change*
because *the quantity and concentration of nutrients required for plant growth will vary. The plants that receive the fertilizer containing the most appropriate quantities of nutrients will be the tallest.*

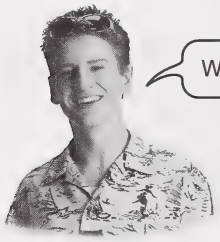
Here is another hypothesis, but it's in a slightly different form. Can you find the information relating to the five parts?

> As the amount of fertilizer increases, the height of a plant will increase until the concentration of fertilizer reaches a certain level. At this point, plant growth will begin to decrease. More fertilizer means more nutrients for plant growth. However, too much fertilizer can damage plant roots and prevent them from getting enough water.

The different form of this hypothesis is fine because the five parts of the information really are presented; you can transform the given hypothesis into the five-part form.

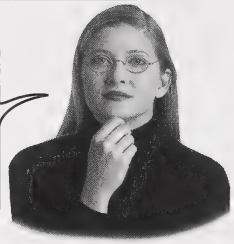
If *you increase*
the *amount of fertilizer given to a plant*,
then the *height of the plant*
will *increase until the concentration of fertilizer reaches a certain level. At this level, plant growth will begin to decrease*
because *more fertilizer means more nutrients for plant growth. However, too much fertilizer can damage plant roots, preventing them from getting enough water.*

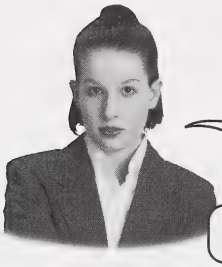
Even if the hypothesis doesn't look like the five-part form, it may still be okay. The important thing is that the hypothesis is clear and has the information relating to the five parts.



Why should the explanation be included in the hypothesis?

Well, suppose the investigation comes out as predicted by the hypothesis. Then the investigation supports the explanation. The explanation gains credibility. Suppose the prediction were just based on whim or a coin toss.





I see. When the investigation comes out as predicted by a coin toss, then there is no explanation to support.

Yes. And explaining things is what science is about.

Investigation 1E Making a Mould

Refer to the "Inquiry Investigation" on page 31 of the textbook.

In this investigation you are to make a hypothesis and design your own procedure. Work with a friend or family member to come up with ideas for your hypothesis and design. You can choose to investigate a variable such as light intensity, moisture, temperature, or the type of bread. Such a variable serves as a manipulated variable.

Think of the following as possible responding variables:

- the amount of surface area covered by mould
- the number of types of moulds growing
- the length of time required for mould to appear

Once you have chosen a manipulated variable and a responding variable, write your own question and hypothesis.

It will likely take a week or two to grow a good crop of mould. You should continue with this module while the mould is growing.

Mould is a biological hazard. Grow the mould in sealed, clear plastic bags. Observe growth without opening the bags. Be careful not to breathe mould in. Wear gloves and wash your hands thoroughly!

Follow steps 1 and 2 of "Procedure" and question 1 of "Analyze."

8. What are the manipulated, responding, and controlled variables for your investigation?

A question you can use to design an investigation should be framed like this:

> How does a change in the (manipulated variable) affect the (responding variable)?

You may also frame the question in a more specific way:

> How does an increase in the (manipulated variable) affect the (responding variable)?

9. Indicate your question for the investigation.

10. What is your hypothesis? Remember the five-part form.

11. List the steps of the procedure for your design proposal. Include the use of a magnifying glass to examine the mould.

12. Indicate how you will record your observations.

Check your answers with your teacher or home instructor.

Once you have received approval from your teacher or home instructor, follow the steps of your procedure.

13. Write a conclusion for your investigation.

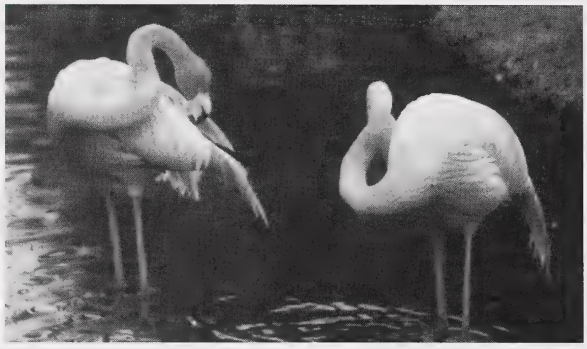
Check your answer with your teacher or home instructor.

end of investigation

Sexual Reproduction

sexual reproduction: any reproductive process that involves two sexes or mating types and results in offspring with genes from both parents

Flamingos and almost every species of living thing use a form of **sexual reproduction**.



Turn to pages 30 and 32 of the textbook and read "Sexual Reproduction" and "Bacterial Conjugation."

14. How do offspring produced through sexual reproduction compare to their parents? Explain why.

15. List forms of sexual reproduction used by moulds, bacteria, plants, and animals.

Compare your responses with those in the Appendix on page 75.

16. List four forms of sexual reproduction.

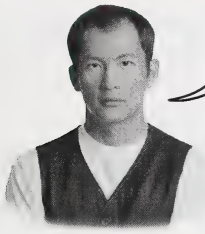
Turn to pages 32 and 33 of the textbook and read "Sexual Reproduction in Plants."

17. Match the following parts of a flower on the left with the appropriate descriptions on the right. There is one extra description.

___ **a.** embryo	A. contains egg
___ **b.** fruit	B. develops from wall of ovary
___ **c.** ovary	C. female reproductive organ of flower
___ **d.** ovule	D. first cell of growing plant
___ **e.** pistil	E. male reproductive organ of flower
___ **f.** stamen	F. multicellular organism during early development
___ **g.** stigma	G. part of pistil that receives pollen grains
___ **h.** zygote	H. structure of flowers in which ovule is produced
	I. first leaf or one of first pair of leaves developed by embryo

Compare your responses with those in the Appendix on page 75.

Having Options



Some young poplar trees are suckers! No, it's not that they're easily taken advantage of. It's just that they're new growth sent out from the root of another poplar tree.

You studied the term *sucker* in Science 7, Module 2: "Plants for Food and Fibre." You know that poplar trees can reproduce vegetatively by growing new plants as shoots from their roots. Such a new tree is called a *sucker*. This mode of reproduction is asexual and is called *suckering*.

But poplar trees can also reproduce sexually. Many plants have such options —they can reproduce both sexually and asexually.

Turn to page 34 and read "Plants Reproduce Sexually and Asexually."

18. Choose plants shown in "Figures 1.31A, B, C, and D" to answer the questions.

a. Which plant is growing from a tuber?
b. Which plant is shown growing from a runner?
c. Which plant is a flowering plant but is growing from a root?

Turn to pages 35 and 36 of the textbook and read everything except the "Topic 3: Review."

19. What is an advantage of internal fertilization?

Compare your responses with those in the Appendix on page 75.

You have now completed the new concepts for Lesson 1. To help you better understand this information, complete the following questions.

20. Turn to page 36 of the textbook and answer questions 1 and 3 of "Topic 3 Review."

Compare your responses with those in the Appendix on page 76.

Looking Back

In this lesson you studied a range of reproductive methods of various species. Also, you applied science inquiry skills in designing and carrying out your own investigation.

Turn to Assignment Booklet 1A. Complete questions 1 to 3 from Section 2.

Lesson 2: Identifying Heritable Characteristics

When you look at some friends, you may be able to see that they have some of their parent's traits. Do you see a mother's eyes and a father's dimples? You may have to look carefully because some of the similarities may be subtle. On the other hand, it's obvious that zebras inherit stripes and elephants inherit wrinkles and trunks. In this lesson you will identify heritable traits and trace them from one generation to another.

Turn to the top half of page 37 of the textbook and read "Wearing Your Genes."

Inherited Variation

Whether you're at the zoo or at the beach, you can see living things that more or less look like their parents. Inherited traits show how genetic material carries traits from one generation to the next.

Turn to pages 37 to 39 of the textbook and read "Two Kinds of Inherited Variation." Include the "Pause and Reflect" on page 39.

1. Classify the variation shown in the following photographs as either continuous variation or discrete variation. Explain your classification.

   a. the coat lengths of the dogs on page 59 of the textbook

   b. the coat colour of the Angus cattle in the left-hand picture on page 61 of the textbook

   c. the number of petals on a flower on page 32 of the textbook

Compare your responses with those in the Appendix on page 76.

You are a unique individual with characteristics inherited from your parents. You are different from and yet similar to your family and friends. In the next activity you will collect data on inherited traits that come in two forms. You are to plot your data on a bar graph.

Review bar graphing skills by going through "Constructing a Bar Graph" on pages 475 and 476 of the textbook.

Find Out Activity Observing Human Characteristics

Refer to the activity on page 38 of the textbook.

Follow the steps of "Procedure." Instead of using students in a class, feel free to use family and friends as the "population" for this activity. Try to get measurements from at least 10 different people.

Draw a table like the one in the textbook. In your table, include a final row marked "Totals." In this row indicate the total number of check marks for each distinct form of a trait. Use the totals to make your bar graph.

2. Show the bar graph as indicated in step 2 of "Procedure."

Compare your response with the one in the Appendix on page 76.

Going Further

A dominant person in a group is the most important, powerful, or influential. The mayor of a town or the captain of a football team is a dominant person.

You may be able to pick out a dominant person in your group of friends—the person who decides what's happening. For example, the dominant person decides whether you are going to the beach or to the swimming pool, playing table tennis at Pat's house, or watching TV at Hyunji's place? Only when the dominant person is absent, does someone else get to have a say.

There are also dominant genes. These genes are said to express dominant traits. The dominant gene must be absent in order for the recessive gene to express its trait—the recessive trait.

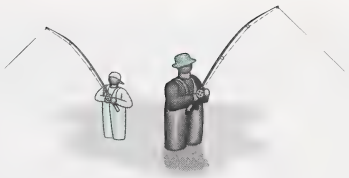
Read all parts of page 40 in the textbook for more about dominant and recessive genes.

3. Refer to "Pause and Reflect" on page 40. Is eye colour an example of continuous variation or discrete variation?

Compare your response with the one in the Appendix on page 77.

Genes or Environment

Do you know people who have interests like fishing? Do you think such a hobby resulted from childhood experiences, or would "it's in the genes" be a better explanation? This question could lead to a debate.



"Nature versus nurture" is an expression referring to this debate. What is the greatest determiner of what an individual becomes? Is it the individual's genetic makeup or is it the childhood environment?

Read "Nature Versus Nurture" on page 42 of the textbook. Don't forget the "Did You Know?" items in the margin.

4. List three characteristics that are affected by both genes and the environment.

Compare your response with the one in the Appendix on page 77.

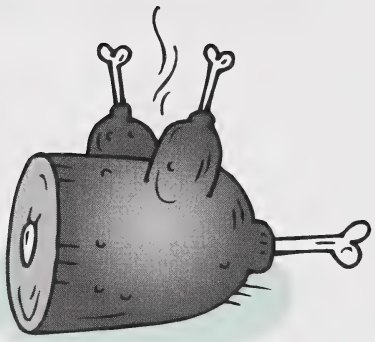
DID YOU KNOW?

The meerkat is a small, carnivorous mammal from southern Africa. Meerkats eat insects, snakes, and small mammals. Meerkats are highly social animals that live in groups.

These mammals take turns standing as sentinels while the others have their heads down and look for something tasty to eat. The sentinel warns the other meerkats when dangerous predators come near.

This co-operative behaviour may be influenced by both genetic and environmental factors.

Damaged DNA



Does your family argue over who gets the turkey drumsticks? Maybe you can imagine a mutant turkey with several legs. This would give everyone a drumstick.

mutation: a change in the genetic information of an organism

The number of legs that an organism has is genetically controlled. When genetic material is damaged, an organism may develop in an unusual way.

Turn to page 43 of the textbook. Find out about **mutations** in "Changing Our Genetic Information." Also read the introductory paragraph of "Find Out Activity: Reducing Cancer Risks."

5. List five mutagens.

6. What does the sickle cell anemia mutation provide protection from?

7. Which factor—nature or nurture—is more important in determining your physical characteristics?

Compare your responses with those in the Appendix on page 77.

8. Turn to page 45 of the textbook and answer questions 1, 2, and 4 of "Topic 4 Review."

Compare your responses with those in the Appendix on page 78.

Looking Back

In this lesson you identified heritable characteristics. There are both discrete and continuous variations of characteristics. Heritable characteristics are passed down from parents to their offspring. Some characteristics are due to environmental influences. You also considered issues represented by the "nature versus nurture" debate.

Turn to Assignment Booklet 1A. Complete questions 4 to 7 from Section 2.

Lesson 3: The Basis of Inheritance

DNA: a molecule that stores genetic information for heritable traits

DNA directs the structure and functions of cells. It stands for deoxyribonucleic acid.

Putting together the pieces of a puzzle can be challenging! You saw pieces of a puzzle as you looked at heritable characteristics, asexual and sexual reproduction, and the variation of characteristics. But how does it all come together to give you a basic understanding of heredity? For the pieces to come together you need to take a look at **DNA**.

Turn to page 46 of the textbook and read the introductory paragraph of "Topic 5: When Plans Change."

DNA

Note: A molecule is the smallest particle of a substance. If this smallest particle is broken apart, the pieces no longer have the properties of the substances. A molecule is made up of atoms.

You will learn more about molecules and atoms in Module 2.

Britain's oldest complete human skeleton is from a man who lived 9000 years ago. The skeleton was found in a cave near the town of Cheddar, England. It turns out that this ancient man has a direct relative living in Cheddar. This person is Adrian Target, the history teacher in the local school.

How was the "generation gap" bridged? Scientists took DNA swabs of students and staff at the teacher's school. When scientists did a DNA comparison between the swabs and DNA extracted from the pulp of the skeleton's teeth, they found a match. Suddenly, Adrian Target had the oldest family tree.

DNA analysis is now used routinely in criminology, taxonomy, and archeology. But when DNA was discovered, little was known about its important role. In the 1800s, Johann Friedrich Miescher first discovered DNA in pus cells from open wounds. Find out more about DNA in the next reading.

Turn to pages 46 and 47 of the textbook and read "DNA: The Secret of Life" and "The Structure of DNA."

A DNA molecule is a molecule that is shaped like a coiled ladder. The sides of the ladder make a spiral shape. Along the sides of the ladder there are four types of protruding attachments. These attachments are distinguished by the labels *A*, *C*, *G*, and *T*. (Labels are the first letters of the chemical names of the attachments.)

The rungs of the coiled ladder are formed from pairs of protruding attachments. But *A* will only connect with *T*, and *C* will only connect with *G*. The order of the protruding attachment—the order of letters in the DNA—determines the order of the rungs.

1. Refer to Figure 1.42 on page 47 of the textbook. Use the labels *A*, *T*, *C*, and *G* to identify the four different rungs going from the left side of the ladder to the right side. **Note:** CG is one of the different rungs and so is GC. The order of the letters is significant.

Compare your response with the one in the Appendix on page 78.

The order of the protruding attachments makes a code. That is, the "letters" (A, C, G, and T) in the DNA carry instructions that control the formation and activities in a living cell. Each functional unit or "word" of the code is called a **gene**.

gene: a section of DNA that codes for a specific protein and function

Turn to page 48 of the textbook and read the first paragraph of "Problem-Solving Investigation 1H: Modelling DNA." Then turn to page 49 of the textbook and read "The Genetic Code" and "The Dance of the Chromosomes."

If the entire DNA from a human body cell were stretched out, it would be two metres long! However, the entire DNA is organized into many short strands that are tightly coiled. These strands are called **chromosomes**. The chromosomes contain the genes, which serve as the basic unit of heredity.

chromosome: a tightly coiled strand of DNA found in the nucleus of a cell

2. Do all organisms have 23 pairs of chromosomes? Explain your answer.

3. Name the scientists who figured out the spiral structure of DNA.

Compare your responses with those in the Appendix on page 78.

Growth and Maintenance Through Mitosis

Have you ever picked up a scratch or a scrape during a sporting activity? While in-line skating, you certainly run the risk of scraping your skin. Fortunately, after such an injury, it usually doesn't take long for the skin to heal again.

The healing process is due to cells dividing. Even without an injury, your body cells continually divide. Before any body cell divides, the chromosomes are copied during **mitosis**.

mitosis: the process by which genetic material is duplicated and divided so that the two new cells have identical sets of chromosomes

Turn to page 50 of the textbook and read "Normal Cell Replacement."

Somatic cells are cells other than the reproductive cells.

somatic cells: cells of the body

4. What process do multicellular organisms use to grow new somatic cells?

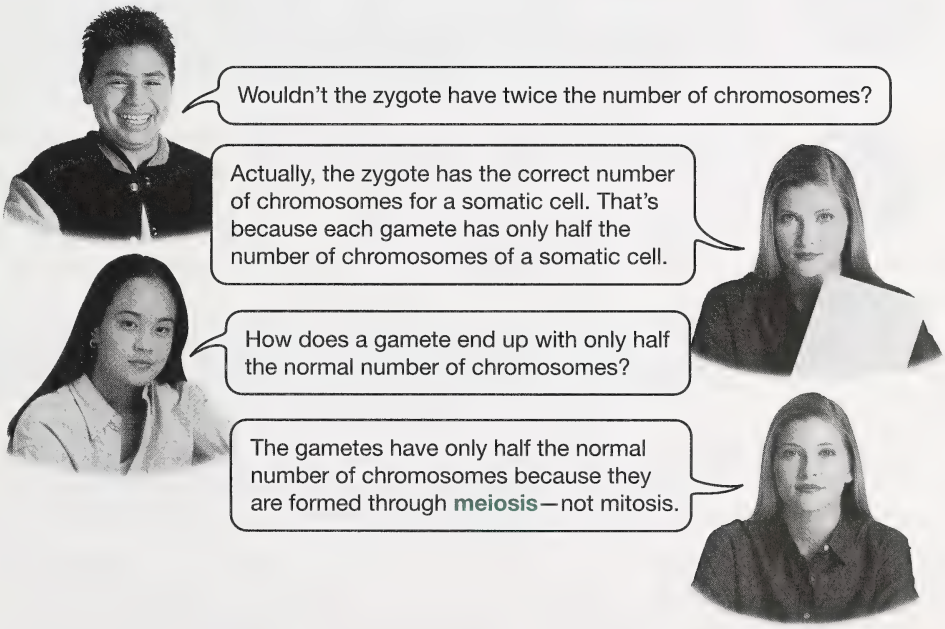
5. Answer the questions from "Figure 1.45."

6. Answer the question from "Pause and Reflect."

Compare your responses with those in the Appendix on page 78.

Reproduction Through Meiosis

You were earlier introduced to fertilization, which is a process of sexual reproduction. You've already learned that two gametes combine to form a zygote. The zygote is the first cell of a new organism. Each of the two gametes contributes its genetic material to the new zygote.


Wouldn't the zygote have twice the number of chromosomes?
Actually, the zygote has the correct number of chromosomes for a somatic cell. That's because each gamete has only half the number of chromosomes of a somatic cell.
How does a gamete end up with only half the normal number of chromosomes?
The gametes have only half the normal number of chromosomes because they are formed through meiosis—not mitosis.

meiosis: the process in gamete formation by which genetic material is duplicated and divided so that each gamete has half the number of chromosomes of a somatic cell

Turn to page 51 of the textbook and read "Sex Cells and Genetic Variation." See "Figure 1.47" for more information about the process of meiosis.

In high school you will get the chance to study mitosis and meiosis in more depth. For now, keep the following in mind:

- Mitosis keeps the genetic material the same as each somatic cell divides.
- Meiosis halves genetic material. A parent cell's genetic material is halved in the formation of gametes.
- The parent cell has pairs of chromosomes. During meiosis, one chromosome from each pair is "randomly" selected. This "random" selection leads to new combinations of chromosomes within the gametes and the resulting zygotes. Therefore, there is greater genetic variation in the offspring.

Do you want to know more about meiosis and mitosis? The following "Going Further" deals with these processes.

Going Further

Use a search engine like Google to search for this string: "How Cells Divide: Mitosis vs. Meiosis," and then go to Nova Online. Or go directly to this site:

http://www.pbs.org/wgbh/nova/baby/divi_flash.html

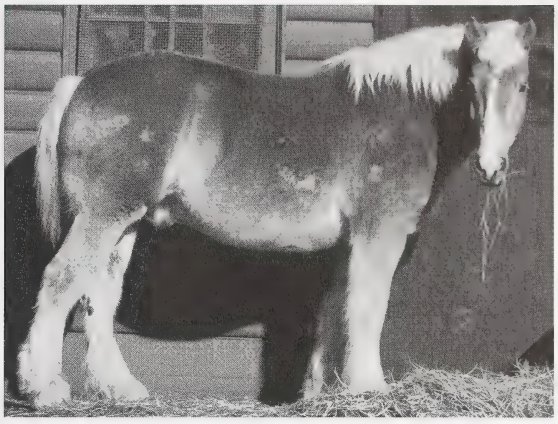
7. Answer the question under "Figure 1.49" on page 52 of the textbook. Think of the pairs of same-coloured marbles as pairs of chromosomes in a parent cell.

8. How many possible combinations of chromosomes could you have inherited from each of your parents?

Compare your responses with those in the Appendix on page 78.

Sexual reproduction causes a recombination of characteristics. Such a recombination contributes to variation in a population. Variation in a population increases the likelihood that the population will survive when environmental conditions change.

Reproductive Technology: The Pros and Cons



People have bred horses and other domestic animals for certain traits. For example, by breeding together strong horses that pull a load well, people can obtain horses that are better draft horses. By breeding only the strongest offspring, people eventually end up with good draft horses with genes for pulling heavy loads. This type of breeding changes the genetic content of a certain cell, the zygote, in an indirect way. As you may remember, the zygote is the cell from which the offspring develop.

genetic engineering: the artificial introduction of genes from one organism into the genetic material of another organism

Genetic engineering is the changing of the genetic material of a cell by direct means. This can speed up changes to the genetic content of a zygote and can even lead to life forms different from anything ever seen before. Genetic engineering is an important tool in **biotechnology**. But there may be harmful consequences to making new life forms. That's why genetic engineering is controversial and is often in the news.

biotechnology: using or modifying living organisms to make marketable products

Biotechnology may involve genetic engineering.

Turn to pages 53 and 54 of the textbook and read "Technology and Variation." Also read the extra features on these pages.

9. Are transgenic characteristics heritable?

10. Is the "EnviroPig" transgenic? Explain.

11. Why are viruses useful to genetic engineers?

12. What problem could arise from the use of genetically modified plant or animal monocultures?

clone: an identical copy of a gene, cell, or entire organism

An individual grown from a somatic cell of its parent is a **clone**. Such a clone is genetically identical to its parent. In cloning, the genetic material from a somatic cell is inserted into an egg cell whose own genetic material has been removed.

Turn to "Decision-Making Investigation 1D: The Cloning Controversy" on page 29 of the textbook. Read "How Can Science Help?" and "Think About It."

13. What is *bioethics*?

Turn to "Decision-Making Investigation 1I: Genetically Engineered Foods" on page 55 of the textbook. Read "How Can Science Help?" and "Think About It."

14. What must each new genetically modified vegetable crop be tested for?

Compare your responses with those in the Appendix on page 79.

15. Turn to page 56 of the textbook and answer questions 1, 4, 7, and 8 of "Topic 5 Review."

Compare your responses with those in the Appendix on page 79.

Looking Back

In this lesson you were introduced to DNA, genes, and chromosomes and their roles in carrying genetic information. You looked at the role of mitosis in the formation of new somatic cells and the role of meiosis in the production of gametes. You also described high-tech methods of modifying genetic material in cells, and you identified issues related to the use of biotechnology.

Lesson 4: Wrap-up

Do the following questions to review the concepts studied in this section.

Turn to page 57 of the textbook and answer questions 1, 4, 5, 6, 8, and 10 of "Wrap-up: Topics 3 to 5."

Check your answers with your teacher or home instructor.

Section 2 Conclusion

In this section you distinguished between sexual and asexual reproduction. You saw the role of these modes of reproduction in maintaining biological diversity. You observed and identified traits that are inherited. You discovered the role of DNA, genes, and chromosomes in heredity. And you considered questions and issues related to biotechnology.

These caribou have a lot in common. They share many physical features because of the way traits are handed down to new generations. Caribou even share the behavioural adaptation of seasonal migration.

You gained an insight into genes and chromosomes as the batons of genetic information handed down to succeeding generations. With this insight you can explain how hereditary traits are passed to new generations of caribou or any other living things.

Turn to Assignment Booklet 1A. Complete questions 8 to 14 from Section 2.

Section 3

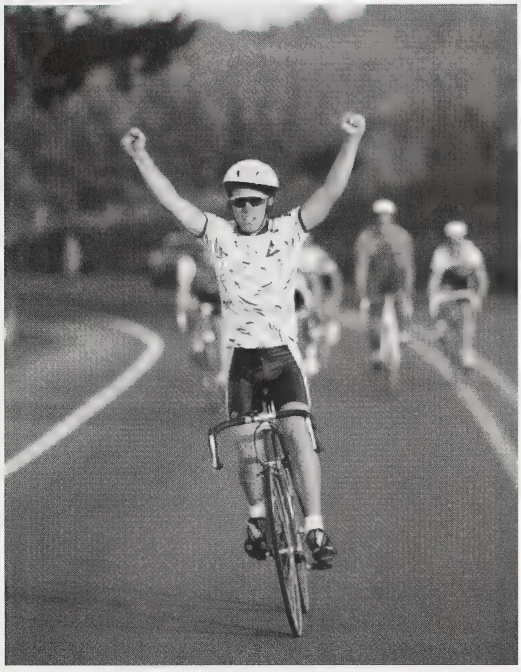
The Impact of Human Activities

You may have been riding in a vehicle when it hit an animal. Or maybe you've seen animals that have been killed on a road by cars or trucks. Roadkill is a common sight on Alberta highways! Deer, frogs, rabbits, coyotes, skunks, porcupines, ground squirrels, birds…. The list could go on and on.

Animals that become roadkill are victims of a human lifestyle that includes motor vehicles. Roadkill can reduce biodiversity. Can the negative effects of such a lifestyle be reduced? This question leads to a more personal question: How does your lifestyle affect biodiversity?

In this section you will examine the impact of human activities on biodiversity. You will investigate the effect of artificial breeding of animals and plants on diversity within species. From this investigation you will gain insight into natural processes that contribute to biodiversity. You will see that some types of human activity can threaten biodiversity but that others can positively affect biodiversity.

Lesson 1: The Best Selection



Imagine winning a first-place trophy as a prize. What would it mean to win the championship for THE BEST individual? That would depend on what "best" you were talking about, wouldn't it? It could be the best cyclist, the best speller, the best in the science fair….

domestic: tamed or bred by humans for a particular function or characteristic

People's ideas of "the best" have affected the development of domestic animals and plants. **Domestic** animals and plants have been produced through **artificial selection**.

artificial selection: a technique in which individual plants or animals with desirable traits are bred together to develop plants or animals with specific traits

The best has another meaning in nature. It has affected the development of living things in natural environments.

Artificial Selection

Have you seen a tiny chihuahua and an enormous Great Dane? These dogs have been developed through artificial selection. The owners of each dog probably thinks the size of his or her dog is the best.

Artificial selection is also called selective breeding.

Turn to pages 58 and 60 of the textbook and read the introduction of "The Best Selection" and all of "Artificial Selection in Agriculture."

1. "Dogs are tailored to fit the human mind like a glove to the hand. From birth, dogs are fluent in human gestures, facial expressions, and body language." Explain how dogs were "tailored" to be so fluent in human social signals.

Compare your response with the one in the Appendix on page 80.

breed: a domesticated variety of an animal or a plant

Members of a **breed** look alike and are related by descent from common ancestors. Have you ever wondered why dogs exist in so many distinct forms or breeds?

The next activity gives you a look at the ancestry of dog breeds. You'll see that selective breeding has led to a great diversity among dogs.

Before doing the investigation, you may want to do some research into characteristics of dog breeds. You can use "dog breeds" in a search engine, such as Google, to find out more.

Check the Internet page of the Canadian Kennel Club at the following site:

http://www.ckc.ca/scoop/purpose/

It shows what dog breeds were bred for. Once at "Original Purposes," you may also find the "CKC Breed Histories" link to be helpful.

Find Out Activity: Why Are There So Many Different Kinds of Dogs?

Refer to the activity on page 59 of the textbook.

2. Do questions 2(a), 3, and 4 from page 59.

Compare your responses with those in the Appendix on page 80.

Do you enjoy milk on your cereal or a tall glass of milk with your lunch? Then it's a good thing cows have been domesticated for milk production.

Domestic cattle come in a variety of shapes, sizes, and dispositions. They have been selectively bred

- to produce meat or milk
- to withstand a variety of environmental extremes and diseases
- for aggressiveness in bullfighting rings
- to pull or carry loads

By examining DNA, scientists traced domestic cattle back to two ancestral, wild species. In the next activity, think about the diversity enhancing process that led to two modern cattle breeds.

You may want to find out more about different types of dairy and beef cattle. If so, use these words in a search engine: "cattle dairy beef."

Or use a search engine to take you to the English site of "The Canada Agriculture Museum." Once there, select "Tour the Farm" and go to "Beef Cattle." Then return to "Tour the Farm" and go to "Dairy Barn." From there, select "Dairy Breeds at the Museum."

Find Out Activity Thoughts on Food

Refer to the activity on page 61 of the textbook.

3. Answer "What Did You Find Out?" questions 1 to 3.

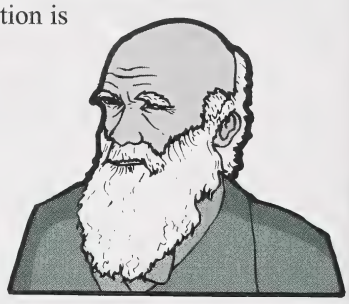
Compare your responses with those in the Appendix on page 81.

The Theory of Natural Selection

When Charles Darwin went on his round-the-world voyage in 1831 he observed a wide variety of living things.

Turn to page 62 of the textbook and read "Accounting for Biological Diversity."

In order to explain diversity, Darwin thought about artificial selection. What criteria make for "the best" in nature? This question is important because such criteria have affected the development of living things in natural environments.



There does not seem to be a single answer to the question. Just think of the turtle and the hare. Both organisms have developed and survived the test of time. If speed was best, the hare would come out on top. If having a protective shell was best, the turtle would be the winner. In fact, both the turtle and the hare are winners in nature.

What makes an organism "the best" depends on the environment in which it lives. Since there are so many different environments, there are many "bests" and a wide diversity among living things.

Turn to pages 64 and 65 of the textbook. Read "The Theory of Natural Selection" on page 64 and "Did You Know?" on page 65.

4. In point form, summarize the theory of natural selection.

5. Where did Darwin collect much of the biodiversity data he based his theory on?

6. **a.** What colour was best for peppered moths before the Industrial Revolution? Explain.

b. What colour was most suitable during the time soot from industrial pollution could actually be seen on trees? Explain.

c. What colour was best for peppered moths after air quality improved in the 1970s? Explain.

Compare your responses with those in the Appendix on page 81.

In "Investigation 1A" you matched the traits of the Galápagos finches to their niches. In the next investigation you will consider the unique plants that have evolved through natural selection on these remote islands.

Investigation 1J Diversity in the Galápagos

Refer to the "Think and Link Investigation" on page 63 of the textbook.

Complete the following questions based on the data table "The Plants of the Galápagos Islands."

7. Answer question 2 of "Analyze."

Most of the islands are within sight of each other and were formed from the same type of rock. Also, the Galápagos Islands have a common climate. But column D of the data table shows that many plant species are confined to only one island. When comparing columns A and D, you can see that from one-third to almost one-half of the total plant species found on each island are unique to that island.

8. Can you think why so many plant species are unique to each island?

Compare your responses with those in the Appendix on page 81.

end of investigation

The Galápagos Islands provided Darwin with much evidence for the theory of natural selection. Find out more by "Going Further."

Going Further

Find out more about this group of islands and the many unique species that inhabit them by doing the "Internet Connect" on page 63 of the textbook.

Go to the site that is indicated in the textbook. Click anywhere in the left graphic. Then click on "Unit 1: Biological Diversity." Follow that by clicking on "Topic 6: The Best Selection." Press on "Internetconnect" and then click on the following "Internetconnect." Scroll down until you find information about the Galápagos Islands.

9. Turn to page 65 of the textbook and answer questions 4 and 5(a) of "Topic 6 Review."

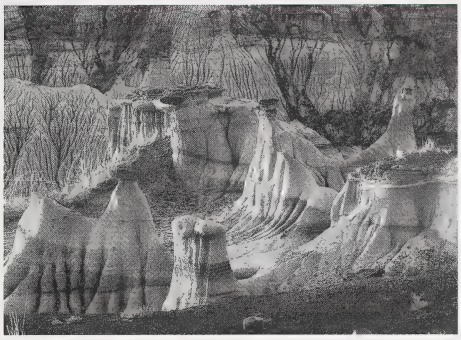
Compare your responses with those in the Appendix on page 82.

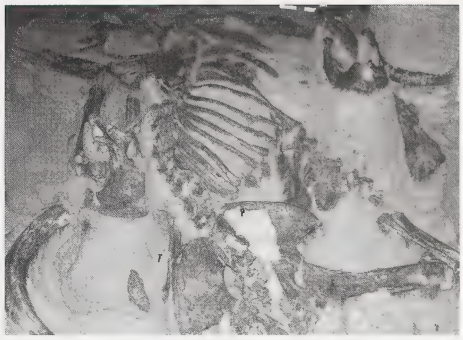
Looking Back

In this lesson you examined how artificial selection led to the development of domestic animals and plants with desirable traits. You compared artificial selection to natural selection. You also studied Darwin's theory of natural selection as an explanation of biodiversity in nature.

Turn to Assignment Booklet 1B. Complete questions 1 to 4 from Section 3.

Lesson 2: The Sixth Extinction





GOVERNMENT OF ALBERTA

Have you visited Drumheller and its nearby badlands? Drumheller calls itself the dinosaur capital of the world. The Drumheller Badlands are one of the few areas in the world where many fossils have become exposed through the natural erosion of sedimentary layers. Even complete fossilized dinosaur skeletons have been found there.

Fossils tell the story of a wide variety of dinosaurs. They dominated the land and waters of our ancient planet for 225 million years. Their story came to an abrupt end with their extinction about 65 million years ago.

Fortunately, the rate of new species forming has been greater than the rate of extinction—at least until very recently. Will human activity lead to another major extinction?

Turn to pages 66 and 67 of the textbook and read "The Sixth Extinction?" and "Cool Tools." Also read the "Did You Know?" items.

1. Refer to the graph in "Figure 1.58." Does the graph indicate that another decline in biodiversity has begun? Explain.

2. Refer to "Figure 1.59," where the animal types are graphed in order of biodiversity. Put the following animal types in order of biodiversity. Order from most biodiversity to least biodiversity.

birds	mammals
fish	reptiles and amphibians
insects and myriapods	

Note: Millipedes and centipedes are myriapods or "many-many legged ones."

Compare your responses with those in the Appendix on page 82.

Human Impacts on Biodiversity

Has the existence of humans changed the "natural" course of species development and extinction? If so, how and to what extent?

Turn to pages 67 and 69 of the textbook and read "Human Impacts on Biodiversity" and "Human Impact on Rain Forest Ecosystems."

3. Look at "Figure 1.60" again. More than heat, light, and rainfall are needed to explain the distribution trend. What other factor do you think influences the trend?

4. Refer to "Pause and Reflect" on page 67. What are some changes that certain species may have trouble adapting to?

5. Why do you think insects have so much biodiversity?

6. Why are rain forests important to biodiversity?

Compare your responses with those in the Appendix on page 82.

Maybe you've worried about bears when hiking or tenting. A close encounter with a bear—especially a grizzly—is best to avoid. Yet, the presence of grizzlies is a good sign. Their being in an environment is an indicator that humans have not interfered with the environment.

Unfortunately, grizzlies have been **extirpated** from many regions. You will consider the plight of the grizzly in the next investigation.

extirpated: exterminated a species from a specific geographic region

Investigation 1K Where Have the Grizzlies Gone?

Refer to the "Think and Link Investigation" on page 68 of the textbook. Read the entire investigation. If possible, have your friends, family, or home instructor participate with you.

7. Answer questions 3 to 5 from "Analyze" and "Extension."

Compare your responses with those in the Appendix on page 83.

end of investigation

Based on the extirpation of grizzlies, it's clear that humans have an impact on biodiversity. Will the impact become greater as the world's human population grows? If so, then it's vital to know how the human population is changing.

In the next activity you will make a line graph showing the growth of the human population. If you need to brush up on graphing, turn to "Skill Focus 10: Organizing and Communicating Scientific Results" on page 473 of the textbook. Then flip the page and work through "Graphing" on pages 474 and 475.

Find Out Activity How High Can It Go?

Refer to the activity on page 70 of the textbook.

8. Prepare the line graph as indicated by "Procedure." Remember that you can use a computer to make the graphs.

9. Answer questions 1 to 3 from "Analyze."

Check your answers with your teacher or home instructor.

Turn to page 70 of the textbook and read "The Population Explosion."

10. The human population seems to be growing at an alarming rate.

a. What factors have recently affected the human population?

b. What negative impact does the human population explosion have on tropical rain forests?

Compare your responses with those in the Appendix on page 83.

It is not only the human population explosion that affects biodiversity. Runaway population growth of other species can also threaten biodiversity. For example, the **feral** horse population was growing too rapidly in the Suffield National Wildlife Area of southern Alberta.

feral: having escaped from domestication and become wild

In the next investigation you will consider an issue relating to the Suffield horses and alternative ways of dealing with the issue.

Investigation 1L The Suffield Horses

Refer to the "Decision-Making Investigation" on page 71 of the textbook.

Carefully read through the investigation. Then follow the steps of "Procedure." If you aren't part of a classroom, you can have friends, family, or your home instructor participate in the activity with you.

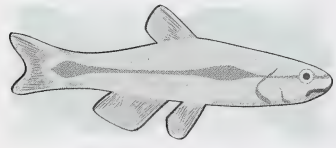
11. Answer all of the "Analyze" questions.

Check your answers with your teacher or home instructor.

end of investigation

Human-Related Extinctions

Banff National Park is a wonderful place to visit. The large vistas of undisturbed mountainous wilderness are awesome. This does not seem to be a scene where you'd expect extinction.



The Banff long-nosed dace is a type of minnow. Do you know what this type of fish looks like? Not likely. In 1982, scientists working in the park noted the end of a species—the last long-nosed dace had died!

The Banff long-nosed dace lived in the marsh below the Cave and Basin Hotsprings. The introduction of tropical fish and the leakage of chlorine from a swimming pool into the marsh contributed to the death of the dace. This marsh was its only known habitat.

Many species throughout the world have been lost due to human activities.

Turn to page 72 of the textbook and read "Human Activities and Extinction."

12. Hunting was a significant factor in the extinction of the passenger pigeon. But it wasn't the only factor. Suggest another possible contributing factor.

13. Answer the "Pause and Reflect" question on page 72 of the textbook.

Compare your responses with those in the Appendix on page 84.

Do you want to know more about Canadian species that have become extinct or are in danger of becoming extinct? Then do the following "Going Further."

Going Further

Find out more about species in Canada that are threatened. Click on the following site:

http://www.speciesatrisk.gc.ca/

This will take you to the page titled "Species at Risk" from Environment Canada. This page is the portal to extinct or endangered species.

14. Turn to page 72 of the textbook and answer questions 1, 3, and 4 of "Topic 7 Review."

Compare your responses with those in the Appendix on page 84.

Looking Back

Extinction has been a "fact of life" ever since life began. In this lesson you focused on the effects of human activity on the rate of extinction. You found that human activity has increased the rate of extinction far above the natural rate.

Near the beginning of Lesson 2, you asked the following question:

Will human activity lead to another major extinction?

The answer may still not be clear. You have learned that the effects of human activity have had a devastating effect on biodiversity. Maybe you are convinced another major extinction is coming due to human activity. Yet, people are now using strategies to minimize the loss of biodiversity. Find out more about these strategies in the next lesson. Maybe knowing about these strategies will be a basis for optimism.

Turn to Assignment Booklet 1B. Complete question 5 from Section 3.

Lesson 3: Pains and Gains

If you've been to a zoo, such as the Calgary Zoo, you can be entertained for hours looking at tigers, giraffes, hippopotamuses, gorillas, monkeys, lemurs, kangaroos, vampire bats, zebras, ostriches, wolves, grizzly bears, whooping cranes…. Note the black and white ruffed lemur of Madagascar in the photo.

You might think a zoo is there just to entertain the visitors. But zoos play an important role in protecting species from extinction. The ruffed lemur, unique to Madagascar, is an **endangered species**. Human destruction of its forest habitat is blamed. Zoos play an important part in providing a safe place for the ruffed lemur and other endangered species.

endangered species: a species in danger of extinction

There have been painful setbacks in biodiversity. Fortunately, concerned people are making gains in halting the loss of species.

Turn to page 73 of the textbook and read the first page of "Pains and Gains."

1. How have zoos changed in the last 200 years?

2. Zoos serve as both a tourist attraction and as a home for protected species. What else does the Calgary Zoo provide to students across Alberta?

Compare your responses with those in the Appendix on page 85.

The Calgary Zoo, along with many other zoos, runs a breeding program to increase the population of certain species. Imagine having to make a choice about which of two "needy" species to support through captive breeding. You will see that data relating to sperm quality and concentration can help you make an informed decision.

Investigation 1M Assessing Breeding Potential

Refer to the "Think and Link Investigation" on page 74 of the textbook.

Look at "Data for Samples of Sperm Taken from Two Endangered Cats." Note that this table is based on just two cats named *Tonghua* and *Chuma*. On the other hand, the bar graphs indicate what is typical for whole species.

The bar graphs allow you to see how the sperm from Tonghua and Chuma compares to their species. You can compare the "percent normal sperm" and the "sperm concentration" to that of their species. However, the bar graphs don't provide a benchmark for "percent sperm moving actively."

3. Do the steps of "What to Do."

4. Do question 1 of "Analyze." A paragraph is long enough for your recommendation.

Compare your responses with those in the Appendix on page 85.

end of investigation

Do you want to visit animals in Canada's largest zoo? Then go to the Toronto Zoo in the next "Going Further."

Going Further

Observe the amazing diversity among animal species!

Go to the following site:

http://www.torontozoo.com/meet_animals/

Follow the links to "Animal Fact Sheets" and "Animal Videos."

Turn to page 75 of the textbook and read "Preserving the Biodiversity of Plants."

genetic diversity: all of the genetic variation within a population or a species

Genetic diversity of a species includes both genetic variations among individuals in a breeding population and genetic variations among different breeding populations. The greater the genetic diversity within a species, the greater the species' potential to adapt to a changing environment.

What is genetic diversity? You can get a sense of it with these examples:

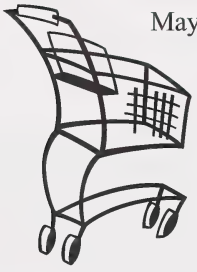
- There is less genetic diversity among dogs of a single "pure" breed than among mongrels or mixed breeds.
- There is no genetic diversity among plants that started from cuttings or suckers of the same parent plant.
- When there are very few organisms left of a species, the species has lost genetic diversity.

Maintaining genetic diversity is an important part of saving a species from extinction.

5. How can tree planters preserve genetic diversity in the wild?

Compare your response with the one in the Appendix on page 85.

A Global Concern



Maybe you have helped shop for groceries. For example, you can choose lamb from New Zealand, rice from California, and pineapples from Thailand. Your choices have global effects.

Because much of human activity has such far-reaching effects on habitats and wildlife, people around the world have to work together to maintain biodiversity.

Read "A Global Effort" on pages 76 and 78 of the textbook. Also read the introductory paragraph of "Find Out Activity: Protected Areas of the World" on page 77.

6. What is one of the main factors affecting many endangered species?

7. How many species have been identified for protection by CITES?

8. Name two Canadian groups formed to increase public awareness and to support conservation efforts.

9. National parks, provincial parks, wilderness areas, and forest reserves in Alberta provide various levels of protection for habitats and wildlife.

   a. Which of these areas provides the highest level of protection?

   b. Which area allows the most hunting, logging, mining, and other human activities? You may have to do a little research to answer this question.

Compare your responses with those in the Appendix on page 85.

10. Turn to page 78 of the textbook and answer questions 2 to 4 of "Topic 8 Review."

Compare your responses with those in the Appendix on page 86.

Evacuees Allowed to Return to Homes

Change in wind could bring flames back on city

LORI CULBERT
Canwest News Service
KELOWNA

About 70 percent of Kelowna's 16 000 forest fire evacuees returned to their homes Wednesday, after fire officials deemed it safe for the public to open all neighbourhoods except those hardest hit by Friday night's destructive inferno.

It was joyous news for a city where people evacuated from their homes have been crammed into hotel rooms, friends' houses, and church basements—and even living in trailers in mall parking lots—for the past five days.

The vast majority of those allowed to return home live on streets in southeast Kelowna that were threatened by the fire, but not damaged. In addition, people who live in the Crawford area—which lost several homes—will also be allowed home because utility crews have deemed it is now safe.

Those who are allowed to return home will be on alert, and will be required to leave again at a moment's notice....

RAFAL K. KOMIEROWSKI

[1]

If you spent the summer of 2003 in Kelowna, B.C., you would never forget the forest fire that threatened the residents. You would be thankful for the firefighters who fought the blazes that encroached on the city.

[1] Lori Culbert, "Evacuees Allowed to Return to Homes." the *Edmonton Journal*, 28 August 2003, A16. Material reprinted with the express permission of Edmonton Journal Group Inc. a CanWest Partnership.

Imagine having to serve on a committee. The committee is to make a decision regarding forest fires that occur naturally in wilderness areas. Should firefighters always be sent into such forest fires? Or should the fires be left to burn out on their own? If you experienced the forest fire at Kelowna, you may have an answer ready. But there really are different sides to the issue. You will find that out in the following "Going Further."

Going Further

"To Burn or Not to Burn" is the issue presented at the end of Unit 1 of the textbook. Consider the social and environmental implications of this issue according to "Unit 1: An Issue to Analyze" on pages 82 and 83 of the textbook.

Use the steps of "Plan and Act" as a guide. You may focus on just the factors (in step 2) that you can address on your own. Feel free to work with family members or friends, and make a short presentation to your home instructor.

Looking Back

In this lesson you identified and evaluated various strategies for minimizing the loss of species diversity.

Lesson 4: Wrap-up

Do the following questions to review the concepts covered in this section.

Turn to page 79 of the textbook and answer questions 1, 2, 4, 8, 11, and 14 of "Wrap-up: Topics 6 to 8."

Check your answers with your teacher or home instructor.

Section 3 Conclusion

KARI GUNSON/TRANSCANADA HIGHWAY MONITORING PROJECT

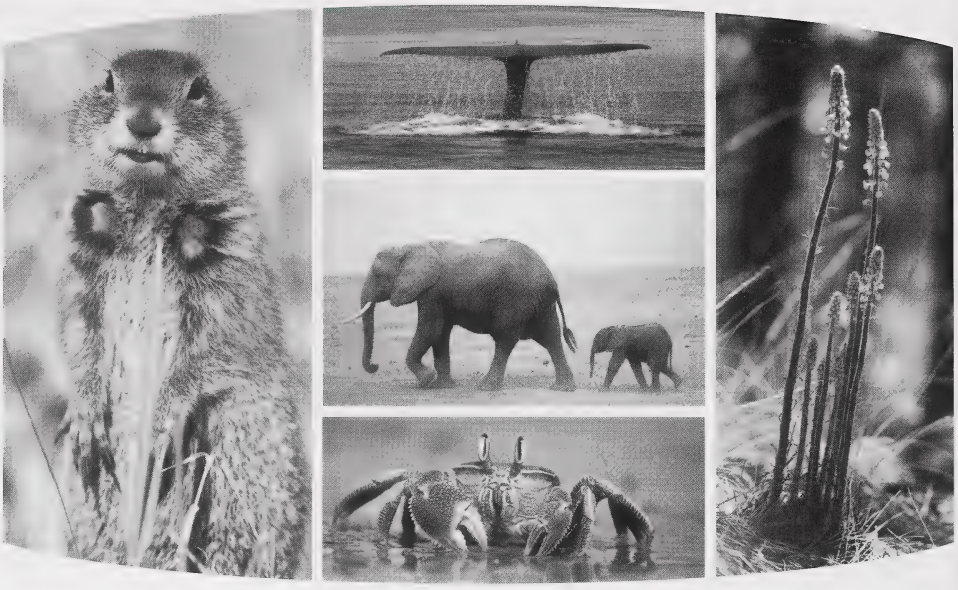
In this section you studied the impact of human activity on biodiversity and distinguished between natural and artificial selection. You identified the threat of human activity on survival and variation. You also evaluated local and global strategies to minimize the loss of biodiversity.

Biodiversity is threatened when animals become roadkill. One local strategy used in the Banff National Park to minimize roadkill is to build wildlife overpasses over the Trans-Canada Highway.

Wildlife overpasses provide elevated paths animals can use to go after food, or to migrate. In this way, overpasses avoid the deadly conflict between animals and motor vehicles. By avoiding roadkill, these overpasses protect against the loss of biodiversity.

Turn to Assignment Booklet 1B. Complete questions 6 to 8 from Section 3.

Module Summary



In this module you learned that biological diversity is due to the natural processes of sexual and asexual reproduction. You saw that human activities do influence the survival of individual species and the variation within species. You studied trends showing a loss of diversity, and you examined issues related to this loss.

You started this module thinking about a small group of living things. This group was made up of a gopher, a horsetail plant, a whale, a crab, and an elephant. These living things are very different—they illustrate an amazing biological diversity. You now know that the biological diversity among all species around the world is even more amazing.

Module Review

Do the following questions to review the concepts covered in this module.

Answer questions 2, 4, 11, 12, 17, 24, 30, and 41 from "Unit 1 Review" on pages 84 to 87 of the textbook.

Check your answers with your teacher or home instructor.

Turn to Assignment Booklet 1B. Complete the Final Module Assignment.

Appendix

Glossary

Suggested Answers

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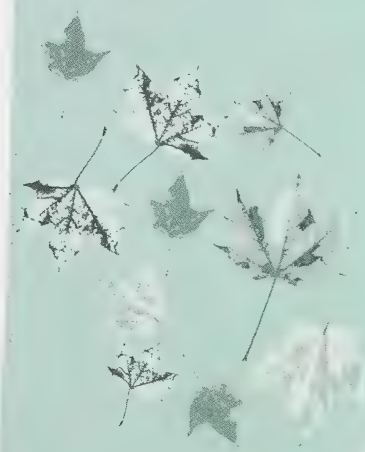


Glossary

adaptation: an inherited structural or behavioral characteristic that increases the chances of surviving of a species or an organism

aquaculture: fish farming

artificial selection: a technique in which individual plants or animals with desirable traits are bred together to develop plants or animals with specific traits

Artificial selection is also called selective breeding.

asexual reproduction: the formation of a new organism from a single organism

Vegetative reproduction is a form of asexual reproduction.

bacterial conjugation: sexual reproduction involving the direct exchange of genetic material between single celled bacteria

behavioural adaptation: an inherited characteristic behaviour that helps an organism survive in its environment

binary fission: the splitting of a single-celled organism into two new organisms which are approximately equal in size

Binary fission is a form of asexual reproduction.

bioindicator species: a species whose presence, absence, population, or health can be used to indicate the quality of an environment

biological diversity: the number and variety of organisms in an area

biotechnology: using or modifying living organisms to make marketable products

Biotechnology may involve genetic engineering.

breed: a domesticated variety of an animal or a plant

Members of a breed look alike and are related by descent from common ancestors.

broad niche: the roles or characteristic activities filled by a generalist organism

budding: asexual reproduction in which a new organism develops as an outgrowth or "bud" from the parent

chromosome: a tightly coiled strand of DNA found in the nucleus of a cell

clone: an identical copy of a gene, cell, or entire organism

commensalism: a symbiotic relationship between two different types of organisms where one partner benefits and the other neither benefits nor is harmed

community: an association of different populations of organisms in a particular environment or geographic area

competition: the struggle among individual organisms for access to a limited resource, such as food or territory

continuous variation: a type of variation in genetics that spans an uninterrupted range of possibilities

For example, variations of height and weight are continuous variations.

controlled variable: a variable that is not allowed to change during an investigation

cotyledon: an embryonic leaf within a seed; supplies food during germination

cross-pollination: pollen from one plant fertilizes eggs in a different plant

discrete variation: a type of variation in genetics that spans a range of discrete possibilities

For example, a variation in the number of fingers is a discrete variation.

diversity index: a measure of the biological diversity in an area

This measure is found by dividing the number of species on a path through an area by the total number of specimens on the path.

DNA: a molecule that stores genetic information for heritable traits

DNA directs the structure and functions of cells, and it stands for deoxyribonucleic acid.

domestic: bred or tamed by humans for a particular function or characteristic

ecosystem: the interactions between living and non-living things in a particular environment

embryo: a multicellular organism during early development

For example, a tiny living plant found inside the seed is an embryo.

endangered species: a species in danger of extinction

environment: the area or conditions where an organism lives

extinct species: a species that no longer lives anywhere in the world

extirpated: exterminated a species from a specific geographic region

feral: having escaped from domestication and become wild

gamete: a reproductive cell—an egg or a sperm

A gamete contains half the number of chromosomes of a somatic cell.

gene: a section of DNA that codes for a specific protein and function

generalist: an organism with generalized requirements and adaptations that allow it to survive in variable conditions and depend on a variety of food sources

Generalists tend to have broad niches.

genetic diversity: all of the genetic variation within a population or a species

Genetic diversity of a species includes both genetic variation among individuals in a breeding population and genetic variation among different breeding populations.

genetic engineering: the artificial introduction of genes from one organism into the genetic material of another organism

genetics: the study of heredity; the transfer of heritable traits from parent to offspring via the genes in the chromosomes

global treaty: an international agreement among many nations worldwide

habitat: the place where an organism lives

heritable trait: a trait that can be passed on genetically from parent to offspring

hypothesis: a prediction of what is expected to happen in an investigation, along with an explanation for the prediction

manipulated variable: the variable that is changed on purpose to see what effect the change will have on the responding variable

meiosis: the process in gamete formation by which genetic material is duplicated and divided so that each gamete has half the number of chromosomes of a somatic cell

meristem: plant tissue that actively undergoes cell division for growth

mitosis: the process by which genetic material is duplicated and divided so that the two new cells have identical sets of chromosomes

mutagen: an environmental factor or agent that can cause mutations

mutation: a change in the genetic information of an organism

It's also a genetic trait not inherited from a parent.

mutualism: a symbiotic relationship between two different types of organisms where both organisms benefit from the partnership

narrow niche: a highly specialized role or characteristic activity undertaken by an organism in an ecosystem

natural selection: a naturally occurring process in which only those organisms with the best traits for survival in an environment survive to reproduce

niche: the role(s) of an organism or species in an ecosystem

A niche has two parts: an organism's habitat and its role.

ova: female gametes (sex cells); the plural of ovum

ovule: the plant structure that develops into a seed after fertilization

parasitism: a symbiotic relationship between two different types of organisms in which one of the organisms is harmed and the other benefits

pistil: the female part of a flower, which produces the seed

The pistil includes the stigma, style, ovary, and ovules.

pollen tube: a tube that grows from the pollen grain on the stigma through the style to the ovule

pollination: the transfer of pollen from an anther to a stigma

population: a group of organisms of the same species found in a particular geographic area

reproductive strategies: methods used by an organism to reproduce

resource partitioning: sharing a resource in ways to decrease or avoid interspecies competition

responding variable: the variable that changes in response to a change in the manipulated variable

seed bank: a collection of genetically diverse seeds

selective breeding: a technique in which individual plants or animals with desirable traits are bred together to develop plants or animals with specific traits

Selective breeding is also called artificial selection.

self-pollination: the transfer of pollen from the anther of a flower on a plant to the stigma of the same flower or the stigma of another flower on the same plant

sexual reproduction: any reproductive process that involves two sexes or mating types and results in offspring with genes from both parents

somatic cells: cells of the body

Somatic cells are cells other than the reproductive cells.

specialist: a type of organism that is adapted to very specific environments and has a narrow niche

specialization: adaptation for a very specific environment

speciation: the process of species formation

species: a group of organisms that share similar characteristics

Generally, organisms of the same species can interbreed and produce fertile offspring.

sperm: male gametes (sex cells)

spore: a single-celled reproductive unit

Spores are produced by certain plants, fungi, and micro-organisms.

stamen: the male reproductive organ of a flower, which includes the anther, filament, and pollen grains

structural adaptation: an inherited physical characteristic that helps an organism survive in its environment

symbiotic relation: an ongoing interaction between organisms of different species that live in close proximity to each other

transgenic: an organism produced by moving genetic material from one organism into another

variation: differences in characteristics of organisms

zoospores: a flagellated asexual spore

zygospores: a sexually produced fungal spore

zygote: a single reproductive cell formed when male and female gametes combine in the process of fertilization

A zygote contains all the genetic material necessary to develop into a new individual.

Suggested Answers

Section 1: Lesson 1

1. The medicinal value of most species has not yet been explored. And the removal of individual species can disrupt natural ecosystems.

2. **a.** A **c.** B
   b. B **d.** A

3. The following are two factors:

   - There is interbreeding among members of a species when they are in their natural habitat.
   - The offspring of members of a species is also capable of having offspring.

4. **Textbook questions 1 to 3 from "What Did You Find Out?" on page 9:**

   1. Answers will vary. The more data you gathered, the better your conclusions will be. It is likely that you found the ranges varied with age and with the gender of the students. Ranges overlapped but you will probably be able to group measurements into identifiable age/gender clusters.

   2. If you have enough samples, your graph should be higher in the middle and sloping down to both ends. In other words, most measurements cluster around the average with a few measurements at each extreme.

   3. The majority of people are right-handed. Right-handed people use their right side more. They are likely to show greater muscle development on their right side. The difference is likely to be more noticeable in adults than it is in children.

5. Variations can be caused by factors such as

   - age
   - rate of growth
   - hand flexibility
   - gender
   - activity levels
   - heredity (or genetic characteristics)
   - nutrition

6. Speciation is the process that leads to the formation of new species.

7. The accumulation of scientific knowledge is a human activity. Scientific knowledge changes, and changes occur when new evidence is gathered and new interpretations of data are made. New and more powerful technologies, such as genetic testing, often lead to new evidence and new interpretations.

   Taxonomy is scientific knowledge and, as such, is subject to change. Because of new data and new interpretations, taxonomists sometimes have to reclassify organisms.

The scientific classification of species may change when taxonomists obtain more evidence. The change could also be due to looking at evidence in a new way.

Note: For some time, it seemed that these groups of orioles did interbreed as if they were one species. Later, the evidence for this type of interbreeding was not considered valid. That's when Bullock's orioles and Baltimore orioles were considered two species again.

Note: You may have thought taxonomy, as scientific knowledge, was "written in stone." That's not true.

8. **Textbook question from step one of "What to Do," page 11:**

   Answers will vary. You should consider differences and similarities in beak size. A likely hypothesis would be as follows.

   > The form of the beak affects its function. For example, large, thick beaks are used to eat large, hard seeds, as well as plant parts or insects. Birds with small beaks must eat small, soft seeds, along with plant parts or insects. Long, pointed beaks allow the birds to probe into cracks. The woodpecker finch could use its beak to pry or pound.
   >
   > This relationship between form and function is for these reasons. A thick beak is strong. A small beak is light in weight but adequate for jobs that do not need much force. A pointed beak can fit into small, deep holes.

   Note: In Section 2 you will review the way a five-part hypothesis is written.

9. Geckos have tiny projections called setae on the bottom of their feet.

   Note: Setae stick to surfaces much like transparent cling film (used for wrapping) sticks to dry glass.

10. **a.** This is a structural adaptation.
    b. This is a structural adaptation.
    c. This is a behavioural adaptation.

11. If there is a variety of characteristics, the species is more likely to be able to survive negative short-term change or adapt to negative long-term change in its environment. Short-term change includes disease, natural disasters, and drought. Long-term change includes climate change, and it also means long-term changes in predation or competition.

12. The diversity index could be lowered by the following human activities:

    - plowing or putting land into pasture
    - using pesticides and herbicides
    - removing trees and other natural vegetation
    - hunting excessively

- building homes or commercial structures
- polluting
- introducing competitive, predatory, or disease-causing species to the habitat

To decide if these activities should be continued, you would need to follow the societal decision-making process. This process involves gathering reliable information for and against alternatives. It is also necessary to investigate possible solutions. You must then weigh the benefits against the drawbacks with the possible solutions in mind.

Note: See "Skill Focus 8: Societal Decision Making" on pages 466 and 467 of the textbook for a review of this process.

13. **Textbook questions 5 and 6 from "Topic 1 Review," page 15:**

    5. Having eyes high on its head would allow the woodcock to watch for overhead predators while listening for and catching worms.

    6. Variation within the species is one reason why some people survived. Some people were more resistant to the disease than others, and their immune systems were able to kill off the germ before it killed them.

Section 1: Lesson 2

1. If the organisms occupy similar niches, interspecies competition can be reduced or avoided by

    - being active at different times of the day or night
    - eating different foods or different parts of a food source
    - occupying the area during different seasons
    - using different parts of the habitat
    - finding alternative sources of shelter or water

    Note: Using the same resource in different ways to decrease or eliminate interspecies competition is referred to as resource partitioning.

2. If the area is diverse and the resources are plentiful, competition can cause an increase in diversity as organisms create and occupy new niches. However, competition could cause a decrease in biodiversity. This will happen if resources are limited. Then the stronger competitor will likely eliminate those species that share the same or similar niches from the area.

3. **Textbook questions from "Figure 1.11," page 18:**

    a. All the warblers are physically similar and all are insect eaters. They reduce competition by having different food preferences. The warblers also have behaviour patterns that further separate them.

    b. Their niches are similar, but different. As long as food remains abundant in the areas in which they specialize, they do not directly compete with each other.

4. Organisms or species that have a narrow niche are very vulnerable to environmental changes that degrade or destroy the state of the environment in which they specialize. These organisms or species are called *specialists*.

5. Species that evolve in an area in which the climate varies greatly must have wide ranges of tolerance for food, temperature, and other matters. In other words, they must have a broad niche.

6. **a.** Three types of symbiotic relationships are the following:

    - mutualism—a symbiotic relationship in which both species benefit
    - commensalism—a symbiotic relationship in which one species benefits and the other is unaffected
    - parasitism—a symbiotic relationship in which one species benefits and the other is harmed

    b. A mutualistic relationship exists between mycorrhizae and plants that have roots. In this relationship the plant absorbs water and minerals and fends off disease better with the help of mycorrhizae. Mycorrhizae obtains nutrients from the plant. Therefore, both organisms benefit.

7. Adaptations for species to extreme environments include

    - producing antifreeze in the tissues
    - protective pigments
    - long periods of inactivity (dormancy)
    - high heat tolerance

8. **Textbook questions 1 and 2 from "Topic 2 Review," page 24:**

    1. A niche is a combination of where the organism lives, and how the organism "makes its living."

    2. **(a)** The two species of squirrels do compete for food. However, variations in their preferred food and habitat keep competition at a low level.

        Red squirrels like pine seeds and cones, while grey squirrels prefer nuts. Red squirrels live in many kinds of forests but mainly in coniferous forests. Grey squirrels prefer deciduous forests.

        (b) Both kinds of squirrels are generalists. They consume a wide variety of plant and animal foods, and they also live in the changeable Alberta climate.

Section 1: Lesson 3

Check all the answers in this lesson with your teacher or home instructor.

Section 2: Lesson 1

1. Four ways in which an individual organism can produce young asexually include the following:

   - binary fission—one single-celled organism divides into two
   - spores—some fungi and plants produce these single-celled reproductive structures
   - vegetative growth—the meristem of a plant is activated and begins to reproduce by growing runners, rhizomes, suckers, or bulbs or by growing roots on cuttings
   - budding—a new individual (a bud) grows on the parent then detaches itself

2. They look alike.

   Note: The offspring will be genetically identical to their parents.You will learn more about genetics in the next lesson.

3. An advantage of asexual reproduction is that it only takes one organism. Also, reproduction can occur quickly.

   A disadvantage is that asexually produced offspring are identical to—are clones of—their parent. A lack of variation decreases the chance that a species will survive a major change in its environment.

4. A zoospore has a tail that allows it to move through water or moist areas. A spore does not have a tail.

5. One meristem function is the repair of damaged tissue. Another function is asexual reproduction.

6. The Mexican whiptail lizard can reproduce asexually.

7. **Textbook question from "Figure 1.25," page 30:**

   The offspring can be supported by the adult.

8. **to 12.** Check your answers with your teacher or home instructor.

13. Check your answer with your teacher or home instructor.

14. Sexual reproduction involves the combining of genetic material from two parents. The new individual acquires characteristics from both parents and is, therefore, unique.

Note: The combining of genetic material in sexual reproduction gives sexual reproduction an advantage.

An advantage of sexual reproduction is that offspring vary rather than being identical. With more variation, there is a better chance of an individual surviving a change in the ecosystem.

15. The following are forms of sexual reproduction used by moulds, bacteria, plants, and animals:

- zygospores—spores that contain genetic material from two parents
- bacterial conjugation—a primitive sexual reproductive process. Genetic material is directly transferred between two single-celled organisms. There is no increase in the number of cells during this process.
- sexual reproduction in plants—genetic material from two parents combine to form zygotes. The gametes of ferns and mosses must be produced in a moist environment to allow the movement of the sperm to the eggs. Angiosperms (flowering plants) and gymnosperms (cone-bearing plants) use a variety of techniques to combine pollen with the egg during self-pollination or cross-pollination.
- sexual reproduction in animals—internal or external fertilization. The egg and sperm join to form a zygote that divides many times to form an embryo.

16. Different forms of sexual reproduction are represented by

- zygospores
- bacterial conjugation
- sexual reproduction in plants
- sexual reproduction in animals

Hint: Refer to "Figure 1.27" on page 30 of the textbook.

17.
a. F
b. B
c. H
d. A
e. C
f. E
g. G
h. D

18. Refer to "Figures 1.31 A to D" on page 34 of the textbook to answer the questions.

a. The potato is growing from a tuber.
b. The spider plant is growing from a runner.
c. Asparagus is a flowering plant but is growing from a root.

19. Internal fertilization provides an appropriate environment for the sperm and the egg, and also for fertilization. It eliminates the threat of predators.

20. **Textbook questions 1 and 3 from "Topic 3 Review," page 36:**

    1. Binary fission and budding are both forms of asexual reproduction. In budding, a new individual grows from the side of the parent and then pinches off to live independently. Binary fission occurs when a single cell duplicates its contents and then divides into two individuals.

    3. Genetic material is exchanged between two individuals but there are no specialized sex cells involved.

Section 2: Lesson 2

1. **a.** The variation is continuous because the coat of each breed grows to a certain characteristic length within a continuous range.

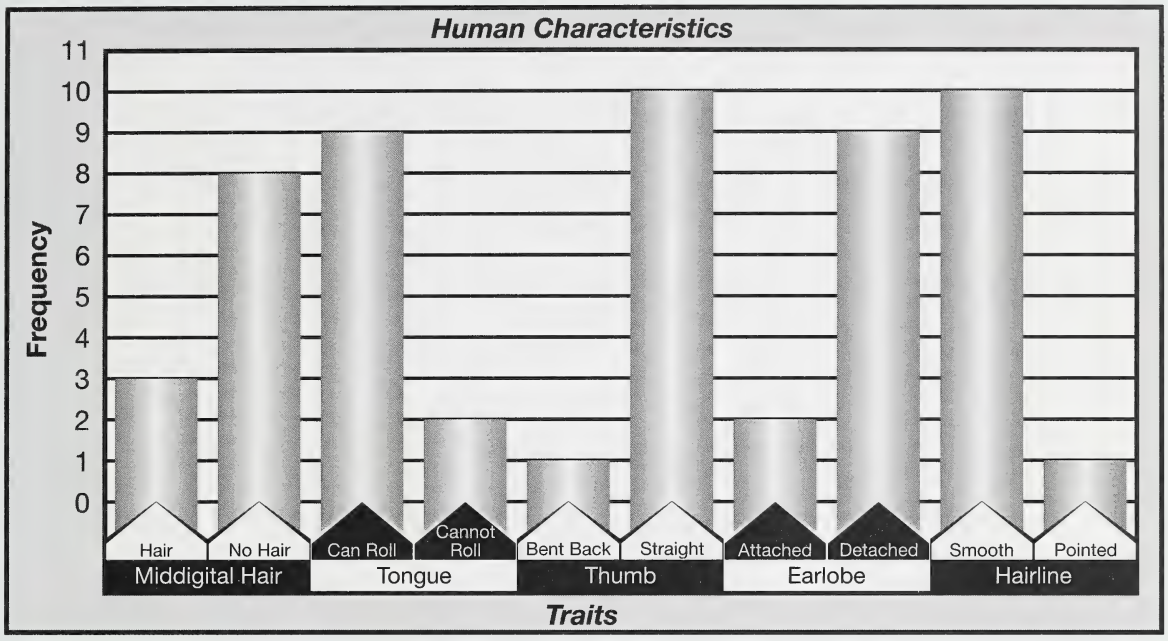
   b. The coats can have a continuous range of similar shades of brown, so the variation is continuous.

   c. The variation is discrete because the petals can only take on discrete whole number values with no possible values in between.

2. **Textbook question from step 2 of "Procedure," page 38:**

   The bar graph in step 2 should have the traits along the horizontal axis. The number of people sharing each trait should be on the vertical axis. The paired variations should be next to each other. Be sure that each axis is specifically labelled and that the graph is titled. The work should have been done in pencil with a ruler, or on a computer. Note the following example of a bar graph, based on information from this table.

Human Characteristics										
Characteristics	**Middigital Hair**		**Tongue**		**Thumb**		**Earlobe**		**Hairline**	
Traits	Hair	No Hair	Can Roll	Cannot Roll	Bent Back	Straight	Attached	Detached	Smooth	Pointed
Totals	3	8	9	2	1	10	2	9	10	1



Note: With a large enough sample size you would find that the most common traits are a rolling tongue, a smooth hairline, detached earlobes, no middigital hair, and a straight thumb. Individual traits can vary widely. Generally, the more closely related individuals are, the more traits they share. These traits are all discrete. However, for those who have a pointed, or v-shaped hairline, its size is a continuous variation.

3. Eye colour is an example of continuous variation. Eye colour possibilities are almost unlimited and are not restricted to discrete values.

4. Body size, body weight, and musical ability are some characteristics that are affected by both genes and the environment.

5. Mutagens include the following:

- X rays
- cosmic rays
- nuclear radiation
- ultraviolet rays
- some chemicals

6. People with the gene for sickle cell anemia are less likely to catch malaria than those without the gene.

7. Answers will vary. Any of the following ideas could be included in your answer. Your environment —nutrition, cleanliness, exercise—acts to shape your body within the range allowed by your genes. For example, hair has the genetic potential to grow quite long. However, humans often cut their hair to a length and shape according to social trends. The amount of exercise you get, which is affected by your environment, affects the fat to muscle ratio of your body. Skin colour has a genetic component, but the amount of sunlight in the environment also plays a part.

8. **Textbook questions 1, 2, and 4 from "Topic 4 Review," page 45:**

    1. It is a continuous variation. There is a fairly wide range of weights in the human population—even an individual person changes his or her weight during a lifetime.

    2. The range for your skin colour is genetically determined but the environment can, for example, tan it or cause it to be wind-blown to a darker colour.

    4. A cancerous or benign tumour can grow and may interfere with surrounding cells and body functions.

Section 2: Lesson 3

1. The different rungs are CG, TA, AT, and GC.

    Note: The order of the listing is not important—they were listed according to the order in which they were found in "Figure 1.42."

2. No. Dogs have 39 pairs of—or a total of 78—chromosomes. Tomatoes have 12 pairs of chromosomes, while cats have 19 pairs of chromosomes.

3. James Watson and Francis Crick determined the structure of a DNA molecule.

4. Multicellular organisms use mitosis to produce new somatic cells.

5. **Textbook questions from "Figure 1.45," page 50:**

    The brain cells live the longest. The stomach lining cells are replaced every two days.

6. **Textbook question from "Pause and Reflect," page 50:**

    Answers will vary. The following is an example.

    > I think it is a good idea. People could get new organs when they needed them instead of waiting for someone to die and donate. There would be no rejection problems. A drawback would be that people would have to wait until an organ could be grown. Selling organs could become a problem if the quality of organs was not strictly controlled.

7. **Textbook question from "Figure 1.49," page 52:**

    There are three pairs of marbles, each of the same colour and each made up of a striped and a plain marble. Each colour represents a different chromosome. Each of the two patterns represents a different form of the chromosome.

You have to think of the number of ways you can choose one marble (striped or plain) from each of the three pairs (yellow, blue, and red). You may have to think back to the statistics and probability part of your math courses. The number of ways to select three marbles so you have one of each colour is $2 \times 2 \times 2$ ways. That is, there are eight ways.

Note: Humans have 23 pairs or "colours" of chromosomes. You can see that the number of ways of selecting 1 chromosome from each of these 23 pairs is very large.

The number of ways is $2 \times 2 \times 2 \ldots \times 2$, with 2 as a factor 23 times. That's 2^{23} ways or 8.4 million ways! Assuming the chromosomes of each pair do differ, that leads to over eight million possible combinations of chromosomes in a gamete—that is almost a guarantee that a gamete of an individual is unique.

8. Each of your parents contributes 23 single chromosomes. Through meiosis, each of these chromosomes is selected from a different pair of chromosomes. That yields 2^{23} possible combinations. See the previous question.

   Note: The number of possible combinations of chromosomes an individual could get from both parents is much larger still! That's why people are so unique.

9. Yes, transgenic characteristics can be passed on to offspring.

10. The "EnviroPig" is a transgenic creation. Genes from bacteria that could break down phosphate were inserted into the pig's genome (genetic material).

11. Viruses can be used to carry new genes into host cells.

12. A lack of genetic diversity could result in entire crops being wiped out by a single pest or disease.

13. Bioethics deals with the moral issues surrounding medical treatment and research.

14. Each new genetically modified vegetable must be tested for toxins and allergens.

15. **Textbook questions 1, 4, 7, and 8 from "Topic 5 Review," page 56:**

    1. DNA is the blueprint for creating and maintaining an organism. The instructions are "written" using a four "letter" code.

    4. Variation within a species increases the species' chances of surviving a change in its environment. Variation between species allows more niches to be filled to their maximum potential. This makes ecosystems less dependent on a few main species and, therefore, more likely to survive the loss of one or more species.

7. Transgenic organisms can be created to

    - be used in genetic studies of inheritable diseases
    - live in particularly harsh or difficult conditions
    - produce better food, larger yields, and/or lower production costs
    - produce large volumes of easily obtained medicines or other chemicals
    - meet specific heritable characteristic demands

8. Biotechnology is currently ahead of bioethics and the law. Modern technologies have given people the ability to mix genes or to clone organisms. The long-term side effects of these new methods have not yet been fully studied and are often not predictable. Genetic and reproductive technologies make things possible that some people consider wrong based on their moral, ethical, or religious backgrounds.

    Other people worry about the effects that genetically-altered organisms could have if they are purposely or accidentally released into the environment. Another worry is that genetically modified food could cause allergy or health problems in consumers.

Section 2: Lesson 4

Check all the answers in this lesson with your teacher or home instructor.

Section 3: Lesson 1

1. Answers will vary. That dogs have been "tailored" means that they were selectively bred over many generations. They were selectively bred to be fluent in human social signals. Only dogs that could best respond to human social signals were mated until this desired trait of fluency became very common among dogs. Modern dogs often behave as if they can read the minds of their owners.

2. **Textbook questions 2(a), 3, and 4 from "Find Out Activity," page 59:**

    2. **(a)** Hounds generally need to be fast, agile, and have a good sense of smell.

    3. Protective breeds include the following:

        - mastiffs
        - bulldogs
        - boxers
        - German shepherds

    4. Selective breeding over many generations increases the occurrence of desirable, heritable, structural, or behavioural traits. Desirable house pet characteristics could include the following:

        - non-shedding
        - quiet
        - attractive
        - small
        - good with children and strangers
        - sociable

3. **Textbook questions 1 to 3 from "What Did You Find Out?" on page 61:**

   1. Beef cattle were selected for the quality and quantity of meat they produced. Beef cattle are often selected for their ability to calve, forage, and otherwise fend for themselves because they are often put out on the range. Jersey cows are selected for the quality and quantity of their milk.

   2. Milk producers must be female but bulls must carry the genes for favourable milk production. Meat producers can be either male or female.

   3. The two types of cattle are actually very much alike except for their genetic abilities to produce milk or meat. Environmental factors such as living conditions—range, barn, or pasture—food, and the amount of exercise can cause differences.

4. The theory, also known as "survival of the fittest," can be summed up this way:

   - More offspring are produced than can survive.
   - There is variation within each species.
   - Some variations increase the chances of surviving to reproduce.
   - Over time, positive heritable variations lead to changes in a species' genetic makeup.

5. Darwin collected much of his biodiversity data from the Galápagos Islands.

6. **a.** Before the Industrial Revolution, it was best for peppered moths to be light-coloured. A light colour allowed the moths to blend in with the lichen on trees. This made it easier to hide from predators.

   b. When industrial pollution in the form of dark soot was on the trees, the moths would be better off with dark colours. That way the moths could more easily hide from predators in trees.

   c. After air quality improved in the 1970s, the trees lost their dark surfaces. As before, a light colour allowed the moths to blend in with the lichen on trees.

7. **Textbook question 2 from "Analyze," page 63:**

   2. It is possible that a plant species found on the Galápagos Islands would also be native to Alberta. This is in spite of the distance separating the locations. After all, seeds can be transported great distances by wind, water, or animals.

      Although specialists adapted to the mild, tropical environment would not be able to survive the harsh climate of Alberta, there are generalists that can live in many places. The data in column B of the chart on page 63 represents generalists. Some of these generalists, such as grass, would likely be able to live in Alberta.

8. Answers will vary. Some reasons why so many plant species are unique to each island are the following:

    - Animal prey or plant competitors on the other islands may have prevented them from surviving.
    - The unique plant species may have become adapted to particular microenvironments found on only one island.

9. **Textbook questions 4 and 5(a) from "Topic 6 Review," page 65:**

    4. The animals were originally taken from the wild. The species developed through natural selection in their normal environment. Once the animals are placed on farms, humans gain control of the animals' breeding. Only selected bulls with characteristics desirable for human purposes are allowed to breed females.

    5. **(a)** Similar problems would be less likely in natural populations. Unhealthy or weak organisms would likely die before they had the chance to successfully reproduce.

Section 3: Lesson 2

1. The graph shows a slight decline in biodiversity. Although it's too soon to tell, the decline could continue.

2. The order from most diverse biodiversity to least diverse biodiversity is the following:

    - insects and myriapods
    - fish
    - reptiles and amphibians
    - birds
    - mammals

3. Another factor that influences the biodiversity trend is human population density. Urbanization and agriculture reduce biodiversity.

4. Some changes that species may have trouble adapting to include the following:

    - major climatic changes such as global warming
    - increasing levels of pollution
    - the destruction and degradation of the habitat
    - the introduction of non-native species (predators, competitors)
    - the introduction of a new disease-causing bacteria or virus

5. The reproductive cycle of insects is very short compared to most other species. Insects produce large numbers of young, and this allows for a great deal of genetic recombination and, therefore, variation. A wide variation both within and between insect species allows them to quickly adapt to changing environmental conditions, and it also permits them to expand into new niches.

6. The amount of heat, light, water, and nutrients available in rain forests promote plant growth. As the number and variety of plants increase, the number of niches available to animals also increase. More animals mean more niches, and so on. The rain forests of the world are far more biologically diverse than are other regions.

7. **Textbook questions 3 to 5 from "Analyze" and "Extension," page 68:**

   3. There are several isolated grizzly populations. Isolated populations may have problems breeding successfully. Their gene pool can become limited, causing health and adaptability problems. The bears may try to move between pockets—this places them in less favourable areas and in greater contact with humans.

   4. Measures to protect grizzlies include the following:

      - conservation laws and protected areas
      - habitat improvement and preservation
      - public education and awareness campaigns
      - co-operation between farmers, ranchers, and preservation groups
      - strict laws that are backed up by active enforcement
      - the creation of corridors for safe wildlife movement between isolated areas
      - the restriction of hiking, camping, and hunting
      - significant consequences for poaching or selling bear parts
      - limiting commercial (e.g., mining, forestry, petroleum collection), recreational, agricultural, and residential development in grizzly territory

   5. Answers will vary because this is an opinion. Your opinion should be backed up by facts from this module or from your own experience. Here is a sample response.

      Grizzlies should not be removed from national and provincial parks. These areas were set up to protect them and their ecosystems. Human presence and activities should be restricted in these areas. Grizzlies should be removed from agricultural areas where they threaten humans or livestock.

8. **and 9.** Check your answers with your teacher or home instructor.

10. **a.** Improved diets and better medicines are factors that have recently affected the human population.

b. The human population explosion has led to the clearance of tropical rain forests. The clearances are used to make small farms, cattle ranches, and coffee plantations.

Note: The development of new technology has also contributed to forest destruction. Just think of logging and transportation technology, such as bulldozers, trucks, and good roads.

11. Check your answers with your teacher or home instructor.

12. Another very significant factor in the extinction of the passenger pigeon was the removal of the forests where the pigeons made their homes. The forests were burned and cut to provide agricultural land.

13. Textbook question from "Pause and Reflect," page 72:

The grizzly bear "cultivates" the soil. The plants that normally benefit from this activity would not grow as well.

Note: The grizzly bear interaction with its environment is part of its niche. If the grizzly is removed from an ecosystem all the organisms it affects, either directly or indirectly, will experience some degree of change in their environment.

14. Textbook questions 1, 3, and 4 of "Topic 7 Review," page 72:

1. Answers will vary. Human activities that affect biodiversity include:

- genetic engineering
- artificial selection
- the destruction or degradation of the habitat for agriculture, forestry, mining, industry, housing, or recreation
- the release of pollutants
- damming rivers
- the extensive use of ground and surface waters
- solid waste disposal

3. It is assumed that rain forest destruction takes with it large numbers of specialized species of plants and animals. It is thought that many of these species become extinct before they can be found and identified.

4. You affect biodiversity by

    - taking up space
    - using fossil fuels
    - eating food produced on agricultural and ranch land
    - using products that produce pollution through their manufacture, packaging, and transportation
    - using imported goods and resources

Section 3: Lesson 3

1. Zoos have progressed from being an amusing collection of wild animals kept in small cages to institutions dedicated to preservation. Animal exchange programs, "natural" environments, artificial insemination, studies of animal health and nutrition, release programs, and a variety of other strategies are being used by zoos to promote and preserve endangered animals.

2. The Calgary Zoo serves as an educational institution for students.

3. **Textbook steps 1 to 3 from "What to Do," page 74:**

    1. The tiger has more actively moving sperm than the cheetah. The higher the number of actively moving sperm, the greater the chance fertilization will take place.

    2. The tiger is normal for his species. Chuma is about 8% above the normal rate.

    3. Tonghua's sperm concentration is normal at 125 million/mL. The cheetah's sperm concentration is significantly below normal for its species.

4. **Textbook question 1 from "Analyze," page 74:**

    1. Answers will vary. Note the following example.

        Tonghua is more likely to succeed in the breeding program. His sperm is healthier and much more concentrated than Chuma's. If only one of the two animals can be in the breeding program, the tiger would be the obvious choice. However, it is also important to consider which species is more endangered as well as alternative programs, like invitro fertilization and artificial insemination, before deciding where the money will go.

5. Tree planters can preserve genetic diversity in the wild by using seeds collected from the forest floor.

6. Poaching is one of the main factors threatening many endangered species.

7. CITES has identified 500 species for protection.

8. The Canadian Wildlife Federation and the Canadian Nature Federation are two Canadian groups formed to increase public awareness and to support conservation efforts.

9. **a.** The national parks area provides the highest level of protection.
   b. The area of the forest reserves allows the most human activity.

10. **Textbook questions 2 to 4 from "Topic 8 Review," page 78:**

    2. Answers will vary.

       For example, I could

       - refuse to buy products made from body parts of endangered animals
       - volunteer to help local conservation efforts
       - be a careful, aware consumer to minimize my personal impact
       - follow the 4 Rs in my daily life
       - decrease my personal water and energy use
       - dispose of hazardous household wastes appropriately
       - volunteer at a zoo, park, or botanical facility that promotes conservation

    3. International co-operation is very important in preserving biological diversity. A united effort to prevent poaching and the sale of body parts from endangered animals is just one example of an action that must be taken to preserve global biodiversity. At this time, gall bladders from poached Alberta grizzlies are sold around the world.

       Developing countries have some of the most ecologically diverse areas. They require the support of other countries to prevent the destruction of these areas. The ecosystems of the world are interdependent and are interconnected by air and water movement. The health of one is influenced by the health of others.

    4. Animals must have plants to survive. Plants not only produce oxygen and remove carbon dioxide from the air, but they remove pollutants from the air, water, and soil. Plants provide food and shelter to other organisms, including humans. They are sources of medicinal chemicals, and they reduce erosion. Removing a plant species will threaten not only other plants, but animal species.

Section 3: Lesson 4

Check all the answers in this lesson with your teacher or home instructor.

Module Review

Check all the answers in this review with your teacher or home instructor.

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